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STABILIZED BASE CONSTRUCTION ON MISSISSIPPI'S ROUTE 15

An Outline of Construction Problems and Their Solution

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Louisville, Kentucky

IN ITS rapid progress toward an adequate highway system, the State of Mississippi is now completing five links totaling approximately 87 miles on State Route 15 from its northern boundary, the Tennessee state line, to Maben on U. S. Route 82. When fully improved, Route 15 and a continuation from Laurel south on U. S. Routes 11 and 49 will provide a highway the entire length of the state at a distance generally of 50 to 60 miles from and parallel to its eastern boundary. In its northern half, the route cuts across the two largest areas in Mississippi which have heretofore lacked modern trunk highways.

This article deals with the construction of two sections of asphalt-stabilized base—one (approximately 18.5 miles) 13 miles of which was completed in August from

Tennessee line to Ripley, and the other of 14.75 miles now in progress from a point near Mantee to the end of the work at Maben. Intervening sections consist in part of surface treatment of fairly recent date and still in good condition, currently constructed cement-stabilized base with light bituminous surface treatment, and concrete slab. The latter type was laid at points where there appeared the greatest necessity and demand for it; while the use of the cement and asphalt-stabilized construction was determined by the character and cost of local materials and partly by sub-soil and drainage conditions.

Also, and of paramount importance, was the necessity of getting maximum mileage for the money available—a necessity which will continue in Mississippi for



*The Traveling Plant
Had a Good Audience.*



Excavating Sand-Clay Mixture at Pit.
The Dragline Is a Koehring with a 1-Yard Bucket.

a long time to come. This consideration affects not only construction types, but locations, grades and widths of roadway. The new construction is in part on the old Route 15 with reduced grades and improvements in alignment, and in part on entirely new location which is frequently a mile or more from the old.

Character and Design of Surface

R. B. Tyler Co. was awarded the contracts for these jobs, including some grading and selected topping material, late in fall of 1938, and work was started about Feb. 1, 1939. The asphalt stabilization work on one job was started about April 1st, and 13 miles was completed in August. The asphaltic stabilization was started on the other job on August 20th.

These two jobs are of the same general character—a stabilized base mixed in a traveling pug mill, spread tamped and rolled, and covered with a 1-in. top of crushed slag bound in asphaltic cement (generally known as surface treatment). On the northerly work the base is 4 in. thick, the aggregate being a mixture of about 85% sand and 15% fines (clay and silt passing a 200 mesh sieve), to which was added approximately 5.5% by weight RC2 as it entered the mixer.

The southern portion has a 6-in. base of aggregate averaging 80% sand and 20% fines mixed with approximately 6% by weight of RC2. Maximum allowable variations are determined to a large extent by the nature of the soil, but the total percentage will vary from 5.5% to 6.5%.

Both roadways are 30 ft. wide between shoulders. On the 4-in. base construction the finished surface is 21 ft. wide, leaving 4 ft. 6 in. shoulders; and on the 6-in. base construction the surface is 20 ft. with 5-ft. shoulders. Specifications require that the 4-in. base be laid 21 ft. 8 in. wide and the 6-in. base 21 ft. wide. The edges are then trimmed on a 45° angle to bring the top of the 4-in. base to 21 ft., and the 6-in. base to 20 ft. finished width. The crown is 1½ in. Four-inch strips of sod are laid on each shoulder—one adjoining the paved surface and one at the shoulder's edge; and the area between is sprigged with live sod at random, contemplating a solid sod later. All of these dimensions are indicated on the accompanying cross-sections.

Materials in Six-Inch Base Job

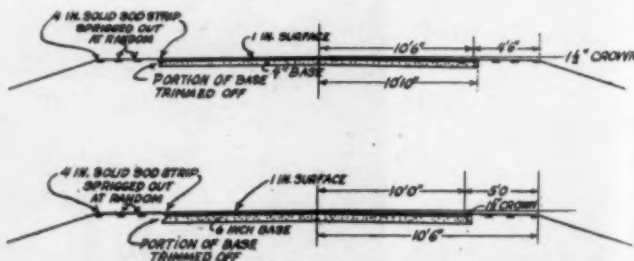
Rough grading was carried to about 15 in. below finished subgrade level, and selected material running about 80% sand was spread to a depth of 15 in. This was considered necessary because of the unsatisfactory character of the natural soil for subgrade purposes. This layer was compacted by sheep foot tamping over the entire roadway width, including shoulders.

For stabilized base material the engineers selected a pit about 2 miles from the work at its nearest point and 10 miles at its farthest. The upper layer of the deposit runs roughly 25% clay and silt and 75% sand, while the lower layers grade down to nearly pure sand at a depth of 15 or 20 ft. To secure the 80% sand and 20% fines desired by the engineers the dragline operator at the pit blends the materials of each load—a process admittedly rough, but sufficient for practical purposes. Seventeen 3-yard loads of this aggregate per 100-ft. station are dumped in a windrow in the center of the roadway. This windrow is not flattened (except when necessary to dry it out) but is allowed to remain as dumped except for evening up by blading the edges.

The 51 yards of material per station is considerably more than enough for the 6-in. base 21 ft. wide, but during the process of compacting, the mixed material is allowed to take its own slope at the edge, which allows the sheep foot rollers to work to a greater width and thus secure a much stronger shoulder line. The excess is trimmed off to a true line later with a motor patrol blade.

Materials and Construction of the Four-Inch Job

On this job the grading was finished to a point about 15 in. below the sub-base of the stabilized roadbed. Selected material was added about 19 in. deep. This selected material was maintained and used as a road for about one year. The material eroded was replaced before the stabilizing began. This material was rolled with



Cross Sections of 4-in. and 6-in. Base Construction.

Due to an error in draughting, the crown is shown on one side only. Actually the sections are symmetrical about center line. Note that the bases are laid 8 in. and 12 in., respectively, wider than the finished surface, and that they are brought to correct width by trimming off a triangular section on each edge.

Aggregate as Dumped in Windrow.

The subgrade will be smoothed with a motor patrol before arrival of the mixer.



a sheep foot roller for its entire width including shoulders. Just ahead of the mixing a trench was cut the width of the finished pavement and to a depth to give enough aggregate for a 4-in. finished pavement. It was found that the material windrowed varied in weight from 840 to 915 pounds per linear foot of pavement to give the desired 4-in. compacted pavement. The variation was due to gradation of aggregate, which ran from 12% to 20% clay and loam below a 200 mesh screen. The RC2 used averaged about 5.5% by weight.

Moisture and Its Control

Moisture content is important, not only because of its effect on the quality of construction but because too much water makes slow curing. Fortunately the natural material seldom runs over 10% or under 8% moisture by weight—an almost ideal condition.

If the windrowed material, however, was either rained on or dried out much we found it necessary to adjust the moisture content to such a degree that after mixing we had from 8% to 11% moisture, including the volatile material in the RC2 cutback asphalt, before we could satisfactorily start compaction. If mix contained more moisture, the surface would develop longitudinal cracks that were undesirable and if the moisture was below 8% the finished surface of the base would be much too dry to finish properly. The dry surface would not go together under a rubber tired roller but would powder and crumble. In regulating the moisture content, if too moist, it was necessary to tear down windrow and dry out with disc harrows and blader. If the windrow was too dry we wet it with a large water tank and a three-inch hose. We were able to add moisture in this manner very satisfactorily by allowing water to spill on top of windrow by gravity.

During the current season on the 4-in. base near Ripley we had an unusually heavy rainfall and suffered expensive delays because of wet windrow. During a few periods we had prolonged dry spells when the windrow became too dry. Later we tried out a paper cover called "Sisalkraft." This was spread on windrow after the moisture had been adjusted as outlined. We found that this cover kept the moisture content constant to a marked degree, both by keeping rain out and preventing the moisture that was in windrow from evaporating.

The Sisalkraft covers are made in various size sheets, but those we are using are 12 ft. wide and 50 ft. long.

They are wound on 2x4 sticks. After they are delivered to the job 3 men can spread about 2,000 lin. ft. per hour on the windrow, anchoring the edges with a shovelful of earth every 15 ft. We keep about 5,000 linear ft. of windrow covered whenever there is any prospect of rain, or when we desire to hold moisture in windrow.

If grading or hauling operations have left any inward slope or any berm at the edge of the grade, weep holes must be cut through to carry the water off quickly.

Preparing the Windrow

After the moisture content has been adjusted, it is generally necessary to correct minor irregularities in the subgrade. When all work with the grader is completed, the base of the windrow should have a uniform width of one ft. less than the width of the intake, or pick-up, on the loader.

In trimming up a subgrade on each side of the windrow we use an ingenious dial, or indicator, suggested by our grading foreman. It consists of a sheet of tin 7 or 8 in. square, marked as shown in the photograph, and fastened to a stake with a single nail through the



Windrow Covered with Sisalkraft as Protection from Rain. In this case the covering was applied to the material as dumped, without waiting for it to be smoothed and evened up by grader. The 2x4's on which paper was wound are laid on top.



An Evened Windrow of Aggregate Kept to Proper Moisture Content by Use of Paper Cover.

center. One of these is set beside each blue-top grade stake, in a position to face the motor patrol grader. The pointer on the dial as shown indicates a cut of 3 in. For a fill, the dial is turned upside down, with pointer indicating the depth. The zero turned up and to one side about 45° indicates that the cut is to be made

on that side, and that the opposite side is approximately at grade.

The zero turned down and about 45° to one side shows a fill on that side.

This device is useful when a man with short template and spirit level checks subgrade from blue-tops, and motor patrol operator does not have to follow directly behind but can follow directions from indicators. It must be remembered that the windrow occupies the center of the roadway, and that each dial indicates what is to be done on one side of the windrow only.

Making the Stabilized Mix

The stabilizing treatment is made with a Barber-Greene traveling plant, sometimes known as a "road mixer." For the benefit of any who may not be familiar with the process, it may be noted that the equipment consists of two main units—a loader which picks up the windrowed aggregate, and a mill in which asphalt is added and thoroughly mixed with the aggregate. When needed, water is also added as the material enters the mill, but this is not necessary on these jobs where moisture content has been adjusted previously. The mill is towed by the loader as it advances astride the windrow.

The process is continuous, and the proportioning entirely automatic. The loader delivers the aggregate to a hopper from which it is measured through a gate on an endless chain feed and delivered to the pug mill, at the



Cut and Fill Indicators for Grader Operator. Although the picture does not clearly show it, a cut has been made through the pile of loose material on the shoulder to expose the grade stake beside which the indicator is set.



Sampling the Windrow for Weight of Aggregate Ahead of Mixer.

A section 1 ft. wide is carefully cut out and weighed with the steelyard. A moisture test is also made.

entrance to which it is sprayed with asphalt at the prescribed rate. Mixing is very thorough, as is evidenced by the fine grain and uniformity of the windrow of material delivered behind the machine.

The volume of aggregate fed to the pug mill can be very well regulated by raising or lowering the gate through which material is fed to the endless chain. However, the bulking factor of the soil due to size gradation and moisture content must be taken into consideration in converting volume of soil to weight in checking proportions of mix. Our most precise check is in weighing the windrow ahead of mixer at fairly close intervals and then deducting the weight of moisture to give us dry weight. In this manner we were able to get a fairly accurate weight of soil for any particular distance. The amount of asphalt going through the mixer can be very accurately determined from a chart furnished with the machine. The rate of asphalt application can be varied by simply changing of size sprockets on the metering pump furnishing the asphalt. The above method gives us a check on proportions of soil and asphalt in mix to a very satisfactory degree.

The rate of travel varies with the size of the windrow and the grade on which the plant is operating. The weight and toughness or compactness of windrowed material also affects speed. Material for the 4-in. base was mixed on level grades at a rate of about 4 lin. ft., or 1.1 cu. yd., compacted finished base, per minute; while for the 6-in. base, the rate is about 3 lin. ft. or 1.2 cu. yd., per minute. These rates are for actual time of travel, and include none of the time which must always be taken out for various reasons. On our 4-in. construction, the plant averaged about 1500 ft. (410 cu. yd.) per 8-hour shift, and on the 6-in. work, is doing about 1100 ft. (430 cu. yd.) per 8 hours, as this is written.

Interruptions and delays result from many causes—such as adjusting machinery, frequent delays for adding fuel to motors, large stones in windrows, etc. It is not generally necessary to stop the mixer to connect and disconnect the asphalt supply tanks.

A refinement on the current job is a screed of steel plates with sharpened edges, bolted to a 6x6-in. timber, and dragged behind the mixer just ahead of the discharge spout. The plates are adjusted to the crown of the road, and the device serves to cut off small high spots and scrape the surface clear of loose material. Each end of



*Traveling Plant and Its Finished Product.
The 1400-gallon tank is towed by a chain as its contents are pumped to the machine reservoir.*

the timber is shod with a large shoe which keeps the screed at the proper level on the subgrade.

The mixer crew consists of:

- 1 loader operator
- 1 mixer operator



*Disc Harrow Working on Windrow.
Paper covers removed from windrow can be seen at each side.*

- 1 man watching hopper and otherwise helping mixer operator
- 2 shovellers trimming windrow ahead of loader
- 2 shovellers cleaning and casting out subgrade material loosened by the screed ahead of discharge spout.



Contractors and State Representatives

Left to Right: G. P. Wilson, Vice Pres., R. B. Tyler Co.; T. W. Vaughan, Project Laboratory Engineer; E. T. Lea, Project Engineer; A. B. Covell, Gen'l Supt., R. B. Tyler Co.



The Drag Used to Smooth Surface Ahead of the Discharge of Finished Material from Spout at Top of Picture. The 21-ft. Cutting Edge Consists of 6 Plates Adjusted to the Crown Curve.



A Covered Windrow of Finished Material.

On thin base construction where the windrow can be made narrower, not more than one man is necessary ahead of the loader.

The RC2 cutback, and also the asphaltic cement used on the surface coat, are furnished by Mexican Petroleum Corporation in tank cars delivered on a convenient siding where a small boiler supplies heat. We haul the



Motor Patrol Blading Out Windrow of Finished Mix.

cutback to the mixer in 1500-gal. tank trucks, three trucks being necessary when the haul exceeds 8 miles over the rough roads of this district. Temperature when delivered to the mixer is 130° to 150° F.



Traveling Plant Coming Down Windrow of Aggregate and Leaving Finished Mix Behind. Tank Truck Waiting at Right to Deliver Its Load.

Base Finishing Operations

The windrow of mixed material is spread with a motor patrol to approximately the finished width and depth as well as crown and grade. Sometimes if the material is a little too damp it is aerated with the blader and disc harrow to proper moisture content before it is spread as above stated, and then it is tamped with sheep-foot rollers in tandem. To secure maximum compression, Blaw-Knox rollers with small, round surfaced feet are used until only about 2 inches of material remains uncompacted. Then the second Blaw-Knox is replaced by a Le Tourneau, whose large, flat-surfaced feet build up a smoother surface in the pavement. Finally a Bros pneumatic-tired roller is used.

During the compacting operation a motor patrol is used to adjust the surface when necessary. When the compaction is secured at or near the top, the sheep-foot rollers are removed and a small windrow of material is cut up with a motor patrol and machined back and forth across the full width of the road, losing a little with each passing. This gives a finer finish and removes roller tracks in surface. During this operation the motor patrol is followed by the pneumatic-tired roller which sticks the loose material to the base. It is necessary that the sheepfooting and final finishing be carried out in a fairly rapid manner, as the mixed material has a tendency to dry out and powder if worked too long.

If for any reason the spreading of the windrow of treated material is delayed the RC2 near the surface loses part of its naphtha by evaporation, and considerable extra blading becomes necessary to mix the surface and inner portions to a uniform quality. A covering of Sisalkraft paper will prevent most of this evaporation, and we now use it whenever delays occur. On one occasion we kept mixed material in a windrow covered with Sisalkraft for 9 days, and encountered no difficulties when we came to place the material.

We have used our paper approximately 10 times, and it is still in a very good state of repair and preservation, in spite of the fact that we have handled it rather roughly in the various applications and removals. Presumably it will last for as many more applications, and with adequate care it should last much longer.

Surface Finish

After the stabilized base is compacted and finished to the required cross section, lines and grades, it is given a tack coat of about 0.3 gal. of RC2 per square yard. This is not a very satisfactory tack: the surface really requires more of a prime shot. This is especially true if the surface is slightly dry or dusty. We have had considerable trouble with this tack coat peeling off. It appears that a more penetrating prime coat would be much more satisfactory.

The tack coat is followed in 3 to 8 days with an application of 0.35 gal. AC12 per square yard. About 39 pounds of crushed slag (maximum size 1 in.) is then spread, broomed to an even cover and rolled. This completes the job except for shoulder trimming and sodding, and certain minor items such as extensions at road connections and intersections and the surfacing of bridges. These latter are covered with 4 in. of premixed material, the structural surfaces having been made that much below finish grade.

Inspection and Control

Rigid control is maintained by the State Highway Department. Aggregate samples from the pit are analyzed, and if the proportion of sand and fines is not within the

prescribed limits, we are instructed to make the necessary adjustment. Samples are taken also from the windrow, and where unsatisfactory, we are required to blade out a portion and add material to make the mixture right. The only trouble of this sort so far experienced has been due to an excess of clay. Quantities are checked both at the pit and at delivery.

Asphalt is tested and its quantity checked by the usual methods.

The completed mix, as it comes from the machine, is tested approximately every 200 ft. for moisture, etc., as well as for asphalt content.

Equipment and Organization

Equipment on the job comprises:

- 2 Caterpillar RD7 tractors
- 1 Caterpillar Motor Patrol
- 2 Allis-Chalmers Motor Patrols
- 2 Blaw-Knox Sheep-foot Rollers
- 2 Allis-Chalmers Tractors
- 1 Galion 12-ft. grader
- 1 Le Tourneau large-faced Sheep-foot Roller
- 1 Barber-Greene Loader and Traveling Mixer
- 1 Pneumatic-Tired Roller
- 1 Etnyre Distributor
- 1 5-ton Tandem Roller
- 3 1500-gallon Feeder Tanks and Trucks
- 1 Small Boiler for Heating Tank Cars

(The trucking of aggregate is sub-contracted.)

Our organization for three 8-hour shifts is as follows, subject to minor variations according to conditions:

- 1 Superintendent
- 5 Foremen
- 1 Timekeeper
- 16 Operators for various machines
- 30 Laborers

Personnels

R. B. Tyler Company's work is under the direction of:

- G. P. Wilson, Vice President
- A. B. Covell, General Superintendent
- P. L. Perryman, General Superintendent.

The State of Mississippi is represented by:

- T. C. Robbins, District Engineer
- E. T. Lea, Project Engineer
- M. C. Tomasetti, District Laboratory Engineer
- T. W. Vaughan, Project Laboratory Engineer.

ROAD vs. RAIL IN ENGLAND

It seems that the British railway companies are blaming the highways for some of the troubles that have beset them. Anyway here is what the editor of the "Kings Highway" has to say about it:

The demand of the Railway Companies for a "Square Deal" may make the more thoughtless among us forget the needs of the highways—that great concern, of which every citizen is a shareholder, and which returns in interest a higher rate than is represented by money values alone.

Democratic Governments need, unfortunately, to have their attention drawn even to some glaring necessities, consequently the persistent rumor that the programme of essential road construction may be reduced fills everybody with alarm.

What is the use of ending the "Road and Rail Feud" if the highways are not to be extended and adequately maintained to meet the ever increasing demands upon them for speed and load? The agreement that has been reached between the two great transport organizations, whereby road hauliers secure greater freedom for the co-ordination of their industry, will become a dead letter unless John Citizen is alive to his own interests.

Further we expect the A.R.P. Authorities will demand sufficient roads for their purposes as Railways are much more vulnerable than Highways. "Safety First" has a double meaning in its application to this important problem.

RIGHT-OF-WAY AID A POSSIBILITY

One of the burdensome, even construction-prevention items, in a road or street improvement program is the matter of right-of-way. Many projects are doomed or held in abeyance for long periods because of the costs for right-of-way. In some cases, some of the states, like Michigan, have been quite successful with their right-of-way division, financially; but in general, this is not the case.

Just before adjournment of the first session of the 76th Congress, Senator Hayden of Arizona and Congressman Cartwright of Oklahoma introduced companion bills "To assist the states in the improvement of highways." These bills, S-2974 and HR7533, respectively, provide for financial aid in right-of-way acquisition and in construction.

They direct the Commissioner of Public Roads to co-operate with states, municipalities, and other public bodies in providing an appropriate and economical means for facilitating the construction, reconstruction, and improvement of post roads, highways, parkways, avenues, streets, grade crossings, underpasses, overpasses, bypasses, bridges, viaducts, and tunnels, including crossings over or under navigable waters and works incidental thereto.

They further authorize the Commissioner of Public Roads to acquire rights-of-way but not until a contract has been entered into with a state, municipality, or other public body to re-purchase such right-of-way.

"The Reconstruction Finance Corporation is authorized to make loans to states, municipalities, or other public bodies to finance, or to aid in financing, the construction, reconstruction, or improvement of road projects and the acquisition of real property or interest in property necessary or desirable for, or adjacent to, such road projects; such loans to be made after the approval by the Commissioner of Public Roads of plans and specifications for such projects submitted by such states or other public bodies, and upon such terms and conditions as will reasonably assure the repayment thereof within forty years, with interest at such rate or rates as may reasonably be expected to reimburse said Corporation for the cost to it of the capital required for the making of such loans."

Highway leaders in Congress are of the opinion that with these bills already in the "hopper" there will be sufficient time between now and the next regular session of Congress for the careful study of the measure and at the same time the various state highway departments will have an opportunity to make plans for their respective programs which might be carried out under this Act.

In order to effect the recommendations of the Public Roads Administration for the relief of highway traffic congestion two important steps have been taken.

1. Surveys and Plans.
2. Acquisition of Rights-of-way and Loans.

Legislation for surveys and plans has been enacted through Section 2 of Bill S-1109.

Acquisition of rights-of-way and construction is enabled in the above mentioned bills through loans to states or other sub-divisions.

Inasmuch as S-2974 and H. R. 7433 do not appear to interfere with states' rights and the program would be carried out under the jurisdiction of the local governmental units serious opposition is not anticipated. This legislation is separate and apart from regular federal-aid and will not in any way jeopardize future federal-aid legislation.

METHODS AND EQUIPMENT USED ON MIXED-IN-PLACE CONSTRUCTION IN FLORIDA

Hillsborough County Builds Roads at \$4000 Per Mile

By **DON JONES**

*International Harvester Co.,
Chicago, Illinois*

HILLSBOROUGH County, Florida, of which Tampa is the county seat, has 1,036 square miles of land area and more than 1,500 miles of roads, of which approximately 250 miles have been rebuilt with mixed-in-place paving during the past eight years, following methods devised by G. F. Bullard, county road superintendent. These methods have given the county an excellent system of paved secondary roads at unusually low cost. The rapid development of farming and citrus growing in the county has made necessary a program of continuous expansion of the hard-surface secondary road mileage.

Under the county's system the basic material of the unimproved roads—whether sand, shell, lime rock, or a mixture of sand and clay—is mixed with tar, disked and bladed to get a thorough mix, and then rolled. A finished road 16 feet wide with 6 inches compacted depth usually costs less than \$4,000 a mile.

Seven Steps in Rebuilding

Here are the various steps in rebuilding a secondary road by this mixed-in-place method (the time figures are based on building a half mile of 16-foot road):

1. Disk the old surface (a wheel tractor pulling a 6½-foot disk harrow usually can do this work in a half day).
2. Grade to establish the contour (two wheel tractors, each with a 10-foot grader, usually do this in two hours).
3. Apply tar.
4. Thoroughly mix the surface with three wheel tractors, two pulling 10-foot graders and one an 8-foot grader, and another tractor pulling a 12-foot grader equipped with a special "hot blade." The mixing usually takes about two days.
5. Roll with 5-ton 3-wheel roller and 6-ton 3-wheel roller. This usually takes about 1½ hours.
6. After ten days apply three-tenths of a gallon of tar per square yard as a surface seal, covering with ½-inch of sand.
7. Finally, after the road has been used about a year, apply a combination of three-tenths of a gallon of tar macadam binder and 30 pounds of trap rock or slag per square yard for surface treatment.

"Hot Blade" a Success

The "hot blade," invented and patented by Mr. Bullard, is credited with much of the county's success in



Meet G. F. Bullard, Road Superintendent of Hillsborough County, Florida.

building these roads quickly and at low cost. It is simply an Adams No. 12 manually controlled grader with a metal oven containing three evenly spaced kerosene burners bolted to the rear of the blade. Perforated baffles diffuse and direct the heat throughout the blade at any desired temperature from 300 to 500 degrees Fahrenheit. A Curtiss air compressor assists in feeding fuel to the burners under 75 pounds of pressure from a 42-gallon tank mounted at the rear of the grader. Ordinarily, 35 gallons of kerosene is enough fuel for 10 hours of work.

The blade has been extended vertically ten inches by welding onto it a curved, heat-resistant steel plate. This extension, which increases the heated surface and yardage capacity 30 per cent, also permits a thorough deep mix with no danger of material coming up over the blade onto the oven.

The heat of the blade increases the fluidity of the bitumen and permits quick evaporation of its volatiles. It has made possible the use of a heavy grade of bitumen that would quickly ball up on a cold blade. In this way Hillsborough county has reduced the gallonage required per square yard and has also obtained what the officials believe to be a much better finished road.

There are several other advantages of the hot blade. Its ability to dry out damp or wet aggregates greatly reduces the construction delays which commonly occur during cold or inclement weather. The consistent, thorough mix obtained, coupled with rapid evaporation and stabilization, makes it possible to spread, finish-blade, roll, and open a road to traffic immediately without having waves, cracks, or ruts develop. This saves construction of detours for traffic during the paving operations.

Although sand is the basic material encountered in rebuilding most of the country's secondary roads, the sand is frequently mixed with clay. However, the methods outlined are followed in rebuilding all roads, or in building new roads of this type, even when the percentage of



Hillsborough County's International Dual Wheel ID-40 Diesel Tractor and Adams No. 84 10-foot Grader. Blading Mixed-in-place Road.

clay is as high as 60. As the proportions of lime rock, shell, and clay increase, more tar is needed to counteract the tendency of the alkali in these materials to attack tar.

Equipment

All work is done by the county with its own road building equipment, which includes one International TD-40 Diesel TracTracTor; one dual wheel ID-40 tractor; two I-30 wheel tractors; one International DS-40 truck; one Kinney distributor; two International Harvester offset disk harrows; four Adams graders; one Austin-Western 3-wheel 5-ton roller; one Bay City dragline, and a 3-wheel 6-ton roller.

TRAVEL ANY TIME

CRITICISM which the writer heard leveled at Colorado, concerning winter snow conditions, is unjustifiable as indicated by an investigation of same. All "through" main routes are kept open in winter and special equipment is located on the 15 mountain passes that receive particular consideration.

On the section of a map of Colorado, shown herewith, the important passes are marked with an "X." Those which are kept open all winter have been circled. Two are not circled, namely Loveland Pass on U. S. 6 near Georgetown, west of Denver, and Red Mountain Pass



Central Portion of Colorado with Important Passes Indicated

MOUNTAIN PASSES

on Colorado Highways

- Indicates passes kept open throughout the year.
- Passes closed in winter during excessive storms or because of snow slides.
- Passes closed to winter travel.

	Location on Map	Elevation	Highway
○ Berthoud Pass.....	E-13	11,314 ft.	U. S. 40
○ Rabbit Ears Pass.....	C-10	9,680	U. S. 40
○ Wilkerson Pass.....	H-15	9,225	U. S. 24
○ Trout Creek Pass.....	I-13	9,346	U. S. 24
○ Tennessee Pass.....	G-11	10,424	U. S. 24
○ Monarch Pass.....	I-11	11,386	U. S. 50
○ Wolf Creek Pass.....	O-10	10,850	U. S. 160
○ La Veta Pass.....	N-16	9,382	U. S. 160
● Loveland Pass.....	F-13	11,992	U. S. 6
○ Fremont Pass.....	G-12	11,318	U. S. 6
○ Raton Pass.....	P-18	8,560	U. S. 85 and 87
● Red Mountain Pass.....	M-6	11,018	U. S. 550
○ Molas Divide.....	N-5	10,000	U. S. 550
○ Kenosha Pass.....	G-14	10,001	U. S. 285
○ Poncha Pass.....	K-13	9,011	U. S. 285
○ Hoosier Pass.....	G-13	11,541	State Highway 9
○ Cochetopa Pass.....	L-10	10,032	State Highway 114
● Fall River Pass.....	C-14	11,797	Both on U. S. 34 in Rocky Mountain Na- tional Park
● Milner Pass.....	C-13	10,759	U. S. 285
● Cumbres Pass.....	P-11	10,003	State Highway 82
● Independence Pass.....	H-10	12,095	State Highway 14
● Cameron Pass.....	B-13	10,285	State Highway 145
● Lizard Head Pass.....	M-5	10,000	State Highway 125
● Willow Creek Pass.....	C-12	9,683	State Highway 135
● Kebler Pass.....	I-8	10,000	State Highway 149
● Spring Creek Pass.....	M-8	10,901	State Highway 149
● Slumgullion Pass.....	M-7	11,361	State Highway 149

on U. S. 550 near Ouray. We understand that these passes are kept open except for very heavy snowfalls and occasional snowslides which take a few days to clean out.

We understand that the Public Roads Administration has been in charge of winter maintenance on Berthoud Pass and Rabbit Ears Pass, both on U. S. 40. However, the State Highway Department has taken over the maintenance of Berthoud Pass and the Public Roads Administration will have charge of Rabbit Ears Pass only.

The toughest passes to keep open are: Wolf Creek, on U. S. 160; Red Mountain and Molas Divide on U. S. 550; Loveland, on U. S. 6 and Berthoud and Rabbit Ears, on U. S. 40. The writer very well recalls his trip over Rabbit Ears and Berthoud on U. S. 40 last spring, when he had to roll down his sleeves, put on his coat, turn on the heater and roll up the windows as he passed through blizzards over these two passes. In the valleys the weather was gray but warm; on the passes, cold and blizzardy. An old-style rotary snow plow was plugging away on Berthoud. The next worst passes are Monarch, on U. S. 50; Fremont, on U. S. 6; Tennessee, on U. S. 24, and Hoosier, on Colorado 9.

Two high passes which are enjoyed by tourists in the summer months are not kept open in the winter. These passes are Fall River and Milner in the Rocky Mountain National Park, on U. S. 34. Roads in the National Park are under supervision of the Public Roads Administration. Due to the fact that the road over the Continental Divide in Rocky Mountain National Park runs for about 15 miles above timber line, the cost of keeping the road open in winter time is prohibitive.

Cumbres Pass on U. S. 285, in southern Colorado, is not kept open because of the prohibitive cost and the fact that there is light travel on the highway, even in summer. There has, however, been some discussion

outside of Colorado to the effect that it would be advisable to keep this pass open, because U. S. 285 can become one of the principal routes north out of Santa Fe.

Considering the concerted snow removal efforts of the Colorado State Highway Department on the main roads of the State, we believe motorists should have no presentiments about scheduling a trip over any of Colorado's main roads in the winter time. Travel now is practically as safe from the Midwest across the Rocky Mountains to the sunny West Coast in winter as it is in summer.

ROTARY SNOW PLOW AS FIRE FIGHTER

Snow removal sometimes involves more than keeping the highways open. For instance, last spring in Houghton County, Michigan, a rotary plow stopped its duties as a snow fighter and became a fire fighter. But we will let the March 25 Evening News Journal of Calumet, Mich., tell the story:

The rotary snowplows used by the Houghton County Road Commission have established a reputation for performing valuable service in the line of duty and snowbound residents of the district have come to regard them as an indispensable aid to the Copper Country, but on Friday one of the rotaries accomplished a deed which certainly is a new one for the book.

The plows have always been advertised as snow fighters, but Friday one of the rotaries working in the Quincy district became a snow and fire fighter simultaneously, proving two things can be done equally well at the same time.

The roof of the Thomas residence in Quincy was afire. The flames began to spread slowly and there was no immediate relief in sight, when suddenly, hearing the noise of the snowplow in the vicinity, someone got an idea. The rotary was immediately summoned but those standing about the house, watching the blaze, still wondered. The big rotary moved closer, neared the side of the residence, and began its work. The whirling snow tossed by the propellers of the big rotary rained down on the roof and in several minutes the fire was smothered. Having done its good deed for the day, the rotary went back to its snow-fighting, leaving some onlookers somewhat astonished. Operating the plow at the time was Arthur Sorsen, with Wilbert Barrons, of Calumet, as his assistant.



This Is the Unit That Extinguished the Fire

MORE TRAFFIC COUNTERS FOR INDIANA.—Plans for the installation of 12 additional automatic traffic counters on the state highway system to compile data on the number of vehicles using various roads, were announced on August 31 by T. A. Dicus, chairman of the State Highway Commission. Six automatic counters are already in operation and have proved a valuable source of information to the Commission and its engineering and research staffs. The counters operate electrically, recording each passing vehicle through the interruption of a beam of light which extends across the road.

STATE AID ROAD BUILDING IN MAINE BY DAY LABOR

By L. D. BARROWS

Chief Engineer,
Maine State Highway Commission

BUDGETS for doing road work in Maine are the outgrowth of legislation dating back to about 1901.

To attempt an explanation of the various financial arrangements and their legal restrictions would require a separate article. In a general way, however, it may be stated that roads are of three classifications; state highways, state aid highways, and third class or town roads. Since practically all of the state roads are completed, i.e., surfaced in some fashion, construction work now is either resurfacing and widening or reconstruction.

It is with the state aid and town roads that this article deals. In general, state aid to towns (townships) is budgeted under six heads, principally: 1, State aid construction; 2, Third class road construction; 3, Special resolves; 4, Federal aid secondary; 5, Unimproved roads, and 6, Special state-municipal allotment.

Distribution of Funds

Table I shows a distribution of highway revenues for the years 1935 to 1940 inclusive. The separation into Title I and Title II for the years 1939 and 1940 is the result of action by the recent legislature and is contingent upon a bond issue vote to be taken this fall. If the \$9,000,000 bonds are voted, the distribution given in Title II will be in force.

On state aid road work, the state furnishes approximately \$2.00 for every \$1.00 furnished by the town. For the \$850,000 set up in the 1939 budget by the state, the towns furnish \$425,000. The item of State-Municipal

allotment, \$800,000, is a direct grant for highway purposes which is to be used in lieu of funds that towns are required to pay to the state for old age assistance. On third class roads, the state furnishes all of the money, approximately \$670,000. For all special resolve work, the state furnishes most of the money; the towns are required to furnish all local material and right-of-way. Each special resolve project is set up by special resolution of the Legislature; the work may consist of construction, maintenance and repair of roads and bridges.

Federal aid secondary funds are expended mostly on state aid roads. In this category the state at the present time furnishes about \$150,000 against the federal \$130,000. For unimproved roads the state apportions annually to towns \$200,000 for repairs.

In all, these funds amount to approximately 3½ million dollars.

Designs Used

The type of work usually done on state aid and town roads is either gravel base or stone base, with a gravel surface usually treated with tar. Figure 1 shows three typical designs used by Maine on state aid road work.

Where poor foundation conditions are encountered, greater than 12 in. of base is employed. For the stone base, rock the size of a man's head is allowed. The rocks are usually hand placed and the base filled with sand and gravel. To remove water that might collect in the trench section employed, blind drains are installed at frequent intervals.

TABLE I
DISTRIBUTION OF HIGHWAY FUNDS BY FISCAL YEARS ENDING JUNE 30

	1935	1936	1937-8	1938-9	1939-40		1940-41	
					Title 1	Title 2	Title 1	Title 2
Bond maturities	\$1,002,000	\$1,251,000	\$1,501,000	\$1,601,000	\$1,701,000.00	\$1,701,000.00	\$1,753,000	\$1,753,000
Bond interest	971,385	925,175	927,385	891,095	839,805.00	839,805.00	776,775	776,775
State municipal allotment					800,000.00	800,000.00	800,000	800,000
Automobile registration	125,000	125,000	130,000	130,000	150,000.00	150,000.00	150,000	150,000
State police	250,000	250,000	270,000	270,000	303,000.00	303,000.00	290,000	290,000
Highway administration	100,000	100,000	125,000	125,000	200,000.00	200,000.00	200,000	200,000
Gas tax rebates	175,000	175,000	190,000	190,000	240,000.00	240,000.00	240,000	240,000
Regular special resolves	150,000	150,000	150,000	150,000	150,000.00	150,000.00	150,000	150,000
State aid construction	1,000,000	1,000,000	630,000	850,000	850,000.00	850,000.00	850,000	1,100,000
Third class construction	700,000	700,000	670,000	670,000	670,000.00	670,000.00	670,000	730,000
Matching Federal aid	700,000	700,000	275,000	275,000	100,000.00	.....	100,000	.....
Grade crossing elimination .....	.....	.....	75,000	75,000	40,000.00	40,000.00	50,000	50,000
Extra special resolves .....	.....	.....	84,680	68,300	162,846.70	162,846.70	116,040	116,040
Matching F.A.S. ....	.....	.....	250,000	250,000	150,000.00	150,000.00	150,000	150,000
Bridge Construction .....	.....	.....	400,000	400,000	400,000.00	.....	400,000	.....
Maintenance—Highways .....	.....	.....	3,400,000	3,600,000	2,225,000.00	2,550,000.00	2,225,000	2,300,000
Maintenance—Bridges	* 3,500,000	*3,500,000	.....	.....	200,000.00	250,000.00	200,000	250,000
Maintenance—Snow removal .....	.....	.....	.....	.....	550,000.00	600,000.00	550,000	600,000
Maintenance—Unimproved roads .....	.....	.....	200,000	200,000	200,000.00	200,000.00	200,000	200,000
Excise tax adm. ....	.....	.....	.....	.....	10,000.00	10,000.00	10,000	10,000
Equipment .....	.....	.....	.....	.....	47,500.00	47,500.00	47,500	47,500
Highway garage .....	.....	.....	.....	.....	140,000.00	140,000.00	140,000	140,000
Grand totals	†\$8,670,000	†\$8,870,000	\$9,278,065	\$9,745,395	\$10,129,151.70	\$10,054,151.70	\$10,068,315	\$10,053,315

*Remainder—approximate. †Approximate.

One of the designs provides for gravel to be spread on top of the earth subgrade to a depth of 12 to 15 in. from ditch to ditch. The central 18 feet of this surface is then tar treated. This leaves gravel shoulders and a gravel base beneath the surface so water may escape promptly from any point. Blind drains are unnecessary with this construction.

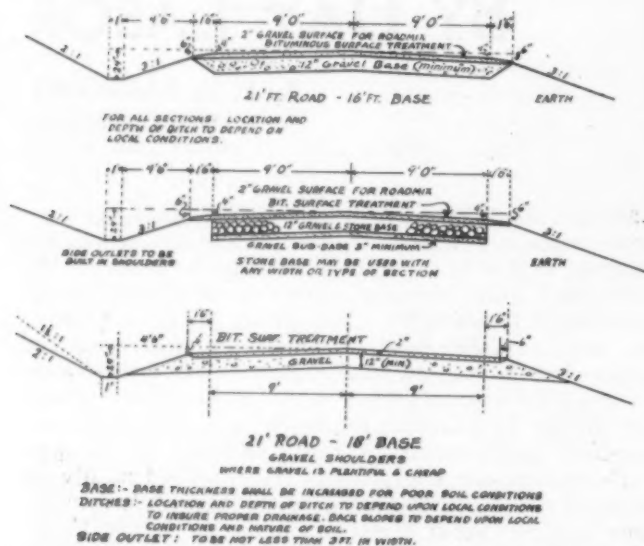


Fig. 1.—Typical Cross Sections of State Aid Road Work.

Equipment Arrangement

A large percentage of state aid construction is done by day labor, and a portion of the federal aid secondary road work. All work done under the rest of the categories of funds is done by day labor. Consequently, the state or towns must own the necessary equipment. To replace the equipment as it becomes worn out, a reasonable rental rate is employed and rental charged against each job for the time it works thereon. This equipment fund suffered quite a reduction during the period 1933 to 1937. A reasonably large sum had collected by 1933 for replacement purposes but it was considered necessary



Fig. 2.—Before, and Fig. 3.—After Construction on State Route No. 24, Richmond Project.



Fig. 3

to appropriate the fund for other purposes. Not only that, but during the same period it was considered advisable, for the good of the work, to use the equipment on a large number of federal projects on which no rental charges could be allowed. The rates shown in Table II are now collected for major equipment items, except on federal projects.

TABLE II
WAGES AND EQUIPMENT RENTAL RATES, 1938 AND 1939

The following rates and hours have been established by the Highway Commission to apply on all day labor construction work under their supervision, except Federal projects.

All work shall be on an eight (8) hour day basis, but shall not exceed 9 hours per day or 48 hours per week.

Superintendents	\$5.50-\$7.50 per day
Foremen	4.00- 5.00 per day
Common labor	0.35 per hour
Power shovel operators.....	0.60 per hour
Helper on shovels.....	0.35 per hour
Compressor drill operators.....	0.40 per hour
Compressor drill blacksmiths.....	0.40 per hour
Timekeepers	0.40 per hour
Two-horse teams, with drivers.....	0.75 per hour
Two-horse teams, without drivers.....	0.40 per hour
Truck drivers in cities having a population of 15,000 or over	0.40 per hour
Truck drivers in cities and towns having a population less than 15,000.....	0.375 per hour
3/4-yd. shovels on state work.....	2.25 per hour
1/2-yd. heavy duty shovels on state work.....	3.00 per hour
1/2-yd. light duty shovels on state work (1939 only)	2.60 per hour
Compressor outfits on state work.....	1.50 per hour
Loaders	0.80 per hour
State owned road graders (construction).....	0.50 per hour

State Equipment: A charge will be made for moving, up to a maximum of eight hours, unless moved by trailer. When trailer is used, a flat charge equivalent to eight hours, rental will be made. Wages of operator (and helper when necessary) for actual time moving are to be considered a charge to the job, and be entered on labor payrolls accordingly.

The following truck rates, not including driver, will be in force on all construction work under supervision of the State Highway Commission:

Trucks having a body capacity of one and one-half (1 1/2) cu. yds. and a registered capacity of not less than 4,000 lbs. but not equipped with hydraulic hoist or motor operated dump.....	\$0.75 per hour
Trucks having a body capacity of one and one-half (1 1/2) cu. yds., equipped with hydraulic hoist or other motor operated dump, and having a registered capacity of not less than 4,000 lbs.....	0.85 per hour
Trucks having a body capacity of two (2) cu. yds., equipped with hydraulic hoist or other motor operated dump, and having a registered capacity of not less than 5,000 lbs.....	1.25 per hour

TABLE II—Continued

Trucks having a body capacity of two and one-half (2½) cu. yds., equipped with hydraulic hoist, and having a registered capacity of not less than 6,000 lbs.	1.65 per hour
Trucks having a body capacity of three (3) cu. yds., equipped with hydraulic hoist, and having a registered capacity of not less than 8,000 lbs.	2.05 per hour
Trucks having a body capacity of four (4) cu. yds., equipped with hydraulic hoist, and having a registered capacity of not less than 10,000 lbs.	2.75 per hour
Trucks having a body capacity of five (5) cu. yds., equipped with hydraulic hoist, and having a registered capacity of over 10,000 lbs.	3.50 per hour

Note: In all cases the weight of the load to be carried must govern registration, rather than the body capacity as stated above.

The towns themselves own many large construction units like power shovels, motor graders, tractors, loaders, trucks, etc. None of this equipment, however, is purchased out of state funds designated for road construction. The towns purchase the equipment out of their own funds, and are allowed the same rental rates as for state equipment.

An accurate record is kept of all equipment rentals, fuel and repair charges. Following is a list of equipment owned by the state for state aid road construction work; maintenance equipment used by the maintenance division is not included:

Power Shovels.—As of December 31, 1938, the state highway department had the following power shovels, 78 in total:

No. ¾-yd.	No. ½-yd.
8 Bay City	2 Speeder
12 Insley	42 General
1 Universal	2 Byers
3 Unit	3 Bay City
—	5 Unit
24	54

The demand for these power shovels is so great that it is necessary to schedule them carefully in advance throughout the construction season.

A record is kept for each shovel under the following headings: Shovel No., Make, Size, Year Purchased, Cost Delivered, Service Charges (Gas, Oil, Repairs, etc.), Total Debits, Total Credits (Rentals) and Standing at end of each year. The "Standing" of each machine at the end of any year is determined by taking into consideration the purchase price, all gas, oil, grease, repairs, and the total of rentals credited to the machine.

The record for 1938 shows the total delivered price of all shovels to have been \$525,575.13, and the net standing on December 31, 1938, to have been \$101,478.29. Had the money to purchase the shovels been borrowed, this standing would represent the amount still owed with earnings only used as payments on borrowings. During 1938 five shovels were replaced with new machines, and the standing as a whole reduced from \$129,626.14 to \$101,478.29.

Since a record is kept of each shovel, it is possible to determine the performance of each and to compare it with the others. As may be noted in Table II, specific hourly rates are charged for shovels by size, regardless of make.

Compressor Drill Outfits.—The state highway department owned the following compressors as of December 31, 1938:

No.	Make	Year Purchased
5	Ingersoll-Rand	1930
5	Sullivan	1930
5	Sullivan	1928
2	Sullivan	1927
6	Sullivan	1926

The annual record of the compressor outfits is kept in the same manner and under the same headings as for power shovels. The total purchase price of all compressors amounted to \$38,444.06 at the end of 1938 and their net standing at that time was \$5,435.59.

As in the case of some of the shovels, several of these compressor outfits have earned more than their cost plus operating expenses for repairs, gas, oil, etc.

As of December 31, 1937, the standing of compressors was \$6,221.22. Service charges during 1938 (gas, oil, grease and repairs) amounted to \$19,854.94, of which \$2,027.35 was expended on trucks on which compressors were mounted. Income from rentals amounted to \$20,640.57, or \$785.63 more than operating costs. The standing was reduced from \$6,221.22 to \$5,435.59 in 1938.



Fig. 4.—Screening Gravel for Surfacing. Portable Screen and ½-Yd. Shovel on Durham Project.

Loaders.—The following tabulation shows the gravel loaders owned by the state highway department as of December 31, 1938:

No.	Make	Year Purchased
21	Conant	1927
3	Conant	1930
4	Conant	1930
10	S. H. C. Garage	1931
2	Conant	1931
8	S. H. C. Garage	1932
—		
48		

The same kind of records are kept for loaders as for shovels and compressors. The equipment report for 1938 shows a total purchase price of \$30,842.16 and a standing on December 31, 1938, of \$25,249.53.

Graders.—No statistics were compiled on graders prior to January 1, 1931. Following is a list of graders owned by the state highway department as of December 31, 1938:

No.	Make	Year Purchased
3	Russell	1931
6	Caterpillar	1932
6	Caterpillar	1932
5	Caterpillar	1934
2	Galion	1938
2	Caterpillar	1938
2	Adams	1938
2	Century	1938
—		
28		

The records show a total cost of \$17,011.97 for these graders and a standing of \$7,544.56 on December 31, 1938.

Day Labor

In prosecuting day labor work, it is necessary that accurate records be kept if we are to know if the work is being done efficiently. While here we are principally

concerned with state aid and a third class road construction, some of the secondary federal aid construction has been done by day labor when the Public Roads Administration has felt that our results have justified approval. In Table III is a summary of construction items showing comparative average unit costs of 1938 construction. The column headed "Average Cost to Contractors (9 Projects)" is a tabulation of records submitted by field engineers as closely as the engineers could keep an account of contract costs. This is not taken from contractors' records, and of course must be accepted as approximate.

TABLE III
COMPARATIVE AVERAGE UNIT COSTS—1938
CONSTRUCTION

Item No.	Description	Unit	Average Cost to Contractors (9 Projects)	Average Cost Force Account (14 Projects)
11	Clearing and grubbing...	Acres	\$141.11	\$197.29
12A	Earth excavation	cu.yd.	.55	.51
12B	Rock excavation	cu.yd.	2.18	2.81
12C	Trees removed	each	6.79	6.35
13	Excavation for structures	cu.yd.	1.22	1.08
	Rock excav. for structures	cu.yd.	2.63	...
16	Stone fill	cu.yd.	.22	...
17A	Common borrow	cu.yd.	.49	.48
17B	Gravel borrow	cu.yd.	...	.51
23	Gravel base course.....	cu.yd.	.56	.60
24	Stone base course.....	cu.yd.	...	1.95
27	Gravel surface course....	cu.yd.	1.24	.96
35A	Class "A" concrete.....	cu.yd.	16.50	18.85
35B	Class "B" concrete.....	cu.yd.	16.50	18.35
38	Cement rubble masonry...	cu.yd.	11.17	8.25
39	Dry rubble masonry.....	cu.yd.	4.43	8.99
47	Hand-laid riprap	cu.yd.	...	1.89
48B	Underdrain Type B.....	lin.ft.	1.32	0.79
51A	Wire cable guard rail....	lin.ft.	.33	0.41
51B	Anchorage for W.C.G.R....	each	7.45	7.79
52	Loam	cu.yd.	.68	...
53B	Seeding	1,000 sq.ft.	2.67	...
54	Sodding	sq.yd.	.55	.44
55	Bituminous treatment ...	gal.	.15	.16
56	Gravel overhaul	yd.mi.	.10	...
	Plank curb	ln.ft.	.14	...
	Field stone curb.....	ln.ft.	.27	...

Table IV shows a summary of average contract prices on federal aid secondary projects for the period June 29, 1938, to August 31, 1938. The heading "Average Price" is the average of successful bidder prices. The heading "Maximum and Minimum," shows the maximum and minimum successful bidder prices, respectively. These figures indicate to the state highway department what they must do if work is to be done on a basis comparable with contract work.

TABLE IV
AVERAGE CONTRACT PRICES—FEDERAL AID SECONDARY PROJECTS—JUNE 29 TO AUGUST

No.	Description	31, 1938 No. of Average Bids Price	Maximum Price	Minimum Price	Unit
11	Clearing and grubbing.	14 \$117.86	\$200.00	\$75.00	acre
12A	Earth excavation	14 .41	.50	.30	c.y.
12B	Rock excavation	14 1.92	2.50	1.50	c.y.
	Unclassified excavation	3 1.03	1.27	.83	c.y.
12C	Trees removed	14 10.79	25.00	5.00	each
13	Excavation for structures	17 1.57	4.00	.65	c.y.
16	Stone fill	2 1.35	1.70	1.00	c.y.
17A	Common borrow	13 .36	.50	.30	c.y.
20	Gravel sub-base	1 .60	...	...	c.y.
23	Gravel base course....	17 .54	.65	.50	c.y.
24	Stone base course.....	1 2.00	...	...	c.y.
27	Gravel surface course.	17 1.07	1.25	.90	c.y.
35A	Class "A" concrete....	4 19.00	20.00	16.00	c.y.
35B	Class "B" concrete....	4 19.00	20.00	18.00	c.y.

TABLE IV—Continued

36	Steel reinforcement for conc. struct.	5	.12	.30	.05	lb.
38	Cement rubble masonry	9	11.22	15.00	10.00	c.y.
39	Dry rubble masonry...	4	8.75	12.00	3.00	c.y.
40A	12-in. corr. metal pipe	13	1.31	2.00	1.25	l.f.
40B	15-in. corr. metal pipe.	15	1.55	2.00	1.40	l.f.
40C	18-in. corr. metal pipe.	11	1.80	2.00	1.60	l.f.
40E	24-in. corr. metal pipe.	5	3.48	5.00	2.65	l.f.
40F	30-in. corr. metal pipe.	2	3.63	3.75	3.50	l.f.
40G	36-in. corr. metal pipe.	1	6.00	....	....	l.f.
41B	15-in. Asphalt coated C.M.P.	2	1.65	1.65	1.65	l.f.
41C	18-in. asphalt coated C.M.P.	7	1.92	2.00	1.75	l.f.
41D	21-in. asphalt coated C.M.P.	1	2.15	....	....	l.f.
41E	24-in. asphalt coated C.M.P.	6	3.16	4.00	2.90	l.f.
41F	30-in. asphalt coated C.M.P.	7	3.98	5.00	3.70	l.f.
41G	36-in. asphalt coated C.M.P.	2	5.13	6.00	4.25	l.f.
41H	42-in. asphalt coated C.M.P.	2	7.00	7.00	7.00	l.f.
41I	48-in. asphalt coated C.M.P.	2	8.00	8.00	8.00	l.f.
41K	60-in. asphalt coated C.M.P.	2	13.50	14.00	13.00	l.f.
43F	36-in. reinf. conc. pipe.	1	4.50	....	....	l.f.
44A	6-in. vitrified clay pipe	1	.40	....	....	l.f.
45A	Drop inlet type "A"...	2	75.00	75.00	75.00	each
45B	Drop inlet type "B"...	2	75.00	75.00	75.00	each
47	Hand-laid riprap	6	2.50	3.00	2.00	c.y.
48B	Underdrain type "B"...	8	1.56	2.00	1.50	l.f.
51A	Wire cable guard rail.	16	.41	.50	.35	l.f.
51B	Anchorage for wire cable guard rail.....	16	8.65	10.00	8.00	each
51C	Anchorage at bridges.	2	8.00	8.00	8.00	each
52	Loam	6	1.00	1.25	.50	c.y.
53B	Seeding	1	15.00	....	....	M.sq ft
54	Sodding	11	.56	1.00	.40	sq.yd.
55	Bituminous treatment..	2	.14	.14	.14	gal.
	Field stone curb.....	3	.43	.50	.30	l.f.
	Stone masonry	1	50.00	....	....	c.y.
	Premixed bituminous gravel surface	1	.35	....	....	s.y.
	Bituminous material for Durfee mixture	1	.15	....	....	gal.
	Plank curb	1	.20	....	....	l.f.
	Scarifying old bituminous treatment	1	.10	....	....	s.y.
	Dynamite for settling fill	1	.30	....	....	lb.
	Stone blanket	1	3.00	....	....	c.y.
	Muck excavation	1	.25	....	....	c.y.
	Boulder guard rail....	1	.25	....	....	l.f.
	36-in. vitrified clay pipe	1	4.00	....	....	l.f.



Fig. 5.—Shovels Are Kept Busy in Winter. Excavating 15 in. to 18 in. of Frozen Ground Without Aid of Explosives.

An interesting comparison is afforded between Tables III and IV. Take the item of Earth Excavation for example. The average cost by day labor was \$0.51 per cubic yard, whereas the successful contractor's bid was \$0.41 per cubic yard. For common borrow the figures

TABLE V
SUMMARY OF COST ANALYSIS FOR 1935 CONSTRUCTION OF STATE AID AND THIRD CLASS ROADS
SMALL JOBS ON THE AVERAGE

	—Earth Excavation—			—Rock Excavation—			—Common Borrow—			
	Quan.	Unit	Amount	Quan.	Unit	Amount	Quan.	Unit	Amount	
Grand totals and average unit cost-hand projects	73,049	0.90	\$ 65,597.18	6,582	2.72	\$ 17,910.69	71,949	0.71	\$ 51,420.57	
Grand totals and average unit cost-shovel projects	201,979	0.57	114,379.96	7,607	2.43	18,449.03	135,666	0.50	67,758.51	
Grand totals and average unit costs—hand and shovel projects combined.....	275,028	0.65	\$179,977.14	14,189	2.56	\$ 36,359.72	207,615	0.57	\$119,179.08	
	—Stone Base—			—Gravel Base—			—Gravel Surface—			
	Quan.	Unit	Amount	Quan.	Unit	Amount	Quan.	Unit	Amount	
Grand totals and average unit cost-hand projects	21,583	1.22	\$ 26,315.34	134,351	1.01	\$135,686.59	45,173	1.26	\$ 56,733.19	
Grand totals and average unit cost-shovel projects	7,303	1.06	7,765.58	222,615	0.69	153,129.35	59,488	1.01	59,851.03	
Grand totals and average unit costs—hand and shovel projects combined.....	28,886	1.18	\$ 34,080.92	356,966	0.81	\$288,815.94	104,661	1.11	\$116,584.22	
	Wire Cable		Culverts Amount	Miscel. Amounts		Length in feet	Cost per ft.		Total Cost	No. of Projects
	G.R. Amount									
Grand totals and average unit cost—hand projects	\$2,935.63		\$21,119.02	\$15,106.18		245,617	1.60		\$392,824.39	158
Grand totals and averages unit cost-shovel projects	5,342.80		34,749.43	13,358.60		344,327	1.38		474,784.29	155
Grand totals and average unit costs—hand and shovel projects combined....	\$8,278.43		\$55,868.45	\$28,464.78		589,944	1.47		\$867,608.68	313

were \$0.48 and \$0.36, respectively. Other interesting comparisons and deductions can be made. As a result of these records, more of the federal secondary work has been done by contract during the present season. In fairness to our day labor work, perhaps we are justified in saying that contractors' bids on this work have been low.

Information was desired on the relative costs between

hand work and machine work on day labor construction. This was gathered at the time when there was a hue and cry about machines displacing men. Table V readily shows the lower unit cost of power shovel work in road construction.

Conclusion

State aid road construction has been carried on in Maine since 1901, and third class road construction since 1920. For the most part this work has always been done by day labor in cooperation with the towns. While these projects have always been under the direction and supervision of the state highway department, local crews have performed the work and a large part of the funds have been expended for labor from each local community. This work has almost become an institution and many people in the towns have depended upon some income each year from such work on the roads. While the projects are small, probably less than \$2,500 on an average, they are carried on each year in practically every town in the state.

The State Highway Commission has considered it advisable to make equipment available for these small projects in order that the work may be done more efficiently and it is believed that there has been a marked improvement in the results obtained on this secondary road construction work.



Fig. 6.—Before and After Construction on Route 24 on Ori's Island Looking North Toward Brunswick.

ASPHALT—ORIGIN, HISTORY, DEVELOPMENT— ITS RELATION TO PETROLEUM

Joseph R. Draney prepared a monograph on the subject given in the title, which was printed in *Americana*, Vol. XXXIII, No. 2, April, 1939. The Asphalt Institute reprinted this discussion in a 32-page booklet. It treats of the origin of the lake asphalts as well as the petroleum asphalts. The booklet is written non-technically and is valuable for the citation of personages and their activities and influences on the development of asphalts for various purposes.

The booklet ends with an explanation of the Asphalt Institute and its work; the Association of Asphalt Paving Technologists; and finally a listing of asphalt producers and asphalt shingle and roofing producers.

SOIL BROCHURE REPRINT

THE ABC'S OF SOIL STABILIZATION is the title of a brochure just published by the Burton Publishing Co., 407 S. Dearborn St., Chicago, Ill. The booklet is a reprint of a series of articles by Arthur R. Smith, published in "The Earth Mover and Road Builder," and sells for 25 cents a copy. The articles discuss the elements of soil stabilization technology. Mr. Smith's excellent method of determining gradation mixtures by means of the tri-axial diagram is explained along with testing procedure. Included are charts on which are plotted curves for mechanical analysis gradation of mixtures as recommended by International Salt Co., The Calcium Chloride Assoc., Indiana and Illinois State Highway Commissions averages, and a suggested specification.

OBSERVATIONS

BY THE WAY

By
A. PUDDLE JUMPER



¶ After driving through the West and Midwest, one "chafes at the bit" when forced to drive at the snail's paces necessary in New England because of antiquated road design or legal speed limitations.

• •

¶ New England needs a loop like the Merritt Parkway of Connecticut.

• •

¶ That New England hurricane destroyed a lot of trees, but it also provided work and revived the lumber industry a little. Maybe it was a good thing.

• •

¶ Diver descending to inspect foundation progress on Pennsylvania Avenue Bridge over Anacostia River, Washington, D. C. Note shoring connections, angle iron bracing, and steel I-beam waling. Pipe entering cofferdam at rear is pumpcrete car-

rier pipe. Concrete is pumped several hundred feet.

• •

¶ I wonder why the city officials of Cambridge, Massachusetts, do not put up street signs on the main thoroughfares of the town? One must drive (I was going to say miles) long distances before he is able to learn the name of the street. It is extremely irksome to strangers. Get busy, Cambridge. Put up some street signs on the corners.

• •

¶ In Massachusetts I noticed a variation in traffic marking on 3-lane roads. Approaching curves on which sight distance is inadequate, or over the brow of hills, a traffic line marks off the right hand lane for ascending traffic in the case of hills, leaving two lanes for descending traffic. The traffic line is stopped on the brow of the hill as soon as sight distance, for the legal speed, is sufficient.

¶ The recent legislature in Maine whipped the dog around the post in such a way as to reduce funds spent for highway work by \$800,000, yet the money taken is not exactly diversion. In other words, it is the answer to the question, "When is diversion not diversion?" By a new law the state grants money to towns (townships), which goes into the towns' general fund to be used on road work, thus permitting the towns to use their funds for old age assistance. Previously, that portion of the towns' funds were used for town road work. A subterfuge of the first order.

• •

¶ My compliments to the State of Connecticut for making the design of every bridge crossover on the Merritt Parkway different. As one drives along this beautiful highway, he is not oppressed by uniformity of standard design on every bridge. One anticipates the pleasure of viewing a new design.

• •

¶ I went through Rhode Island so fast, I was across the state before I realized it. My impression is about as follows: Connecticut, trees, black top roads, Providence, trees, concrete road, Massachusetts.

• •

¶ If you want to see something different, like a foreign country, visit Cape Cod, Massachusetts. Narrow, crooked roads abound. Quaint is the most descriptive word I can think of at the moment to express how it impressed me. Would I want to live there?—No.!

• •

¶ Were someone to ask me what I thought of the roads in New England, again my reply would be, "quaint." Most of them have too much crown, to my way of thinking, and are too narrow and crooked. The scenery, though, is enjoyable.





¶ Herewith a type of bridge design I've never seen before. It's the bridge at Hancock, Md., on U. S. 522. Note



the pin connections and open construction on the pier.

¶ In Hartford, Connecticut, I saw the safety island layout shown herewith. In this large intersection traffic was channelized and certainly the arrangement is far superior to any traffic light setup. Note the separation of each island.

¶ Did you ever hear of a rubber road? A composite surfacing material of 70% to 86% aggregate, 9% to 15% asphalt cement, and 5% to 15% powdered rubber has been proposed. The mixture, using rubber, is patented. A filler must be used and the mixture is heated to a temperature below that which would melt the rubber.

¶ This is the first time I ever saw the highway guard cable carried continuously from posts on the fill across



concrete posts on a bridge. This picture was taken in Vermont on Route 14 at the junction with Route 110.

¶ After reading the July, Montana Center Line, my impression is that you fellows think you're a tough, hardy lot. You should talk with some of the New England oldsters.

¶ Like a "ton of brick" falling on a paper box, the voters of North Dakota said "No," when given a chance at the election on July 11, regarding the diversion of practically all highway funds to old age assistance.

¶ Welded steel stringers replace wood for Miami County, Ohio,



bridge. Structure is a pin connected through truss. The old bridge was too good to discard. The new steel stringers give it a new life.

¶ "You Can Do It Better With Gas"—if you don't believe us, follow one of these big buses and you'll be convinced. One of these days, someone is going to make some money for himself by inventing a way to combat those deadly carbon monoxide fumes

emitting from the motors of the "big boys."

¶ Frost heaves in Utah and Idaho have certainly wrought havoc with the roads this year. This picture in Utah shows some typical heaving.



¶ Mama says the hardest time to get the baby to go to sleep is when she's about 18.

¶ An experimental device for the motorist to see over hill tops consists of 68 glass prisms which refract the light rays. A driver can see an approaching car, but the figure is distorted. It is good at night—glare is eliminated. Cost? About \$3,000.



This Outfit Is Located on U. S. 5, the Berlin Turnpike. It's Called a "Trafficscope."

The taxes levied against motor trucks amount to approximately 47 per cent of their valuation.

American Road

WASHINGTON, D. C.

JOHN M. CARMODY TO ADDRESS

Down the Road

by CHARLES M. UPHAM

*Engineer-Director,
American Road Builders' Association, Washington, D. C.*

GOOD ROADS, GOOD MOVIES, GOOD MANNERS

Last night, or perhaps it was last week, you sat in your local moving-picture theater and you saw your favorite Hollywood stars act out a story that sent you away well pleased with what you received in return for the quarter you left with the girl in the box office. It was the story, let us say, of the rise of a young man to an enviable place in the business or political world. He fell in love, of course, somewhere in the process and his movements and those of his associates were screened against a background of good manners, good speech and good living. You saw, too, a travel short of Brazil which stressed coffee, the great industry of that country. You were shown and told how the bean is cultivated and prepared for export to the far corners of the globe, to be served up at countless dining tables to please the palate of mankind. To complete a program of well-rounded interest, you next were taken to the capitals of the world on the magic carpet of the modern talking newsreel. Now, I know that I have reached that point where you are ready to say, "Well, yes, it was a good show, come to think of it, but what's that got to do with roads?" I'll tell you.

Although you did not pay particular attention to them, there were quite a few farm families in the audience that night, movie fans who didn't know the meaning of the term before the building of an all-weather highway in front of their farm made them only a gallon of gas and a twenty-minute drive away from town and its picture show. So the farmer, who used to take only the boys along when he went to town once a month for supplies, because the trip was too hard and too long over unimproved dirt roads, now bundles the whole family into a new touring car, whenever they choose, and off they go to see "Union Pacific" or "Goodbye Mr. Chips" or "Stanley and Livingstone."

What is so wonderful about that, you may ask. Just this. The American farmer and his family are educated every time they drive to town and sit through a movie program. The newsreels parade before their eyes the major events of the world. They are brought face to face with the important personalities who make the news and who make the laws under which men work and live. They are transported to distant lands to see and hear about places and things that never even existed in their imaginations before a good road was built that decreased distance and diminished time between farm and town.

Last summer I visited a small town in Florida. One night the friends with whom I was staying took me to the show. The population of the town is three thousand and the one theater seats about three hundred. It was Tuesday night and I was amazed to find a crowded house. The picture, while not what you would call a special attraction, was a good one. I had been laboring under the popular impression that Saturday night was the big time in small-town circles, but here was a crowded theater on a week night. I decided to have a chat with the manager on my way out.

"Isn't that a mighty good crowd for a week night?"

"Yes, sir, it is," he replied.

I told him that I had always thought that Saturday night would be the big night for the average small-town theater.

"Well," he said, "it used to be that way up to a few months ago, but now we get a good crowd like that about three times a week."

"What brought about the change?"

"The state finally decided to pave three roads out of town to the west,

JOHN M. CARMODY TO ADDRESS ROAD SHOW-CONVENTION BANQUET

The men who build the nation's roads will be given an exceptional opportunity to learn the nation's road-building plans at first-hand during the 1940 Road Show and Convention of the American Road Builders' Association in Chicago, January 29-February 2. John M. Carmody, first administrator of the newly created Federal Works Agency, which houses the Public Roads Administration, will be the principal speaker and guest of honor at the annual banquet and international ball, a Road Show-Convention highlight.

Chicago's International Amphitheater, scene of the conclave, is appropriately named, for the 1940 exposition will be international in attendance and in importance. Thirty-six foreign countries, as well as the 48 states, will be represented among the more than 40,000 delegates expected. "Roads Rule the World" will theme note exhibits and convention sessions. The major role played by highways in the world's peace, prosperity and progress will be emphasized.

More exhibits of road-building machines and materials will be displayed in Chicago than have ever before been collected under one roof. Manufacturer members are asking for 15 per cent more exhibit space than they utilized at the Cleveland show in 1938. Space applications are pouring in daily to the Washington offices of the ARBA.

Highway contractors, state, county and municipal officials, engineers, manufacturers, distributors, educators and planners will find discussions of special interest in the well-rounded program of convention sessions.

the north and the south, and all of a sudden the people out in the country started coming to town more often and in larger numbers. They soon learned that they could drive to town over the good roads, make a movie and drive back home in time to get to bed by a decent hour. That's when my business started getting better. You can't beat good roads for bringing folks to town."

Good roads have opened up the door to new adventures for the average farm family. Good roads conveniently bring them to town to thrill to the screening of films that give them a liberal education in what to wear, what to say, how to act—motion pictures that teach them good living for the price of admission and a gallon of gas!

Builders' Review

SEPTEMBER, 1939

World registrations of motor vehicles in 1938 rose to 43,297,597, highest figure ever attained.

ROAD SHOW - CONVENTION BANQUET

With Our State Groups

GEORGIA

Charles M. Upham, engineer-director of the American Road Builders' Association, will be among distinguished guests at the annual Highway Jam-boree in Lithia Springs, Ga., on September 21. Sponsored by the Georgia Highway Contractors' Association, this meeting and barbecue is expected to attract members of the highway departments and contractors' associations of Alabama, Florida, Illinois, Michigan, Pennsylvania and the District of Columbia. A softball game, golf matches and horseshoe pitching are on the program for the meet. Up-to-the minute news on the progress of the current highway program will be briefly presented. Paul L. Andrews, secretary of the Georgia affiliate of the ARBA, is in charge of arrangements for the meet.

MICHIGAN

ARBA President and Michigan State Highway Commissioner Murray D. Van

Wagoner and John A. Long, engineer-manager of the ARBA County Highway Officials' Division, will address the annual meeting of the Northern Michigan County Road Commissioners Association in Traverse City, September 28-29. Other speakers announced by Frank N. Smith, president, include L. J. Rothgery of the Michigan State college; Harry Blandford, chairman, Newaygo County Road Commission; Dr. Louis Webber, executive director, Michigan Association of Road Commissioners and Engineers; Thomas B. Lynch, chairman, Lake County Road Commission; Sidney Medalie, chairman, Antrim County Road Commission; Carl T. Bowen, Ottawa County road engineer, and John Jacoby, attorney for the Wayne County Road Commission.

TENNESSEE

The Tennessee County Highway Association and the Tennessee County Judges Association recently held a two-day joint meeting at Dunbar Cave, near

Clarksville. John A. Long, engineer-manager of the ARBA County Highway Officials' Division, addressed the group and the highway association appointed a committee to consider possibilities of affiliating with the American Road Builders' Association.

TEXAS

The Texas Good Roads Association has inaugurated a statewide "Travel Texas Safely" campaign. A series of educational cartoons based on the actual record of Texas traffic accidents for 1938 are now being run by a large group of Texas newspapers. The campaign has been endorsed by the state highway department and the state public safety department. Julian Montgomery, state highway engineer, conducted a conference of district engineers in Austin, August 17-18. Preliminary plans for the 1941 program were discussed, as well as other departmental problems.

JOHN E. UPHAM WINS YALE SCHOLARSHIP

John E. Upham, son of ARBA Engineer-Director Charles M. Upham, has been awarded one of the seven Alfred P. Sloan, Jr., scholarships for study at the Yale University Bureau for Street Traffic Research. In addition to full tuition for the 1939-1940 academic year, the award includes \$1,000 in cash. Young Mr. Upham, who is 23, is a graduate of his father's alma mater, Tufts college at Medford, Mass.

This is interesting news, and many ARBA members will wonder whether son will follow father in the highway construction field.

REDWOOD EMPIRE ASSOCIATION JOINS COUNTY DIVISION

The County Highway Officials' Division of the ARBA has announced the affiliation of the Redwood Empire Association as a group member of the national highway organization. The new affiliate is a non-profit travel promotion group and government instrumentality operated by eight counties in California and one in Oregon. Officers include Paul E. Mudgett, president; George P. Anderson, past president; Frank P. Doyle, treasurer; Clyde Edmondson, general manager, and Elliot M. Epsteen, counsel.

LESS ROAD MONEY DIVERTED IN 1938

State governments in 1938 diverted \$3,129,000 less in highway-user funds than during 1937, according to figures released by the ARBA Statistical Division. This completes a two-year downward trend in the misappropriation of road money to non-highway purposes. Most of the money diverted went to state general funds. Relief, education, irrigation, aviation, harbor improvement, flood relief and debt service were among other projects for which diverted funds were used. Such news is encouraging and should stimulate all our efforts toward correcting the diversion evil.

SOILS SELECTED FOR UNCONTROLLED FILL COMPACTION

Variety of Soil Types Encountered on Seven-Mile Job in Syracuse District

FILL compaction on highway embankment construction has not been controlled in the Syracuse district of the New York State Highway Department by soil testing to the degree that it has been done by highway departments in other states. The first job in this district where soil density has been considered in embankment construction is that now in progress between Alton and Wolcott, New York, on U. S. 104. This highway follows the line of an old obsolete road and the new profile which provides for 1,000 ft. sight distances through rolling country, makes it necessary to fill in numerous places up to depths of 25 ft. Although ordinary methods used in embankment construction are generally very satisfactory, special provisions were incorporated in the specifications to secure greater density and more stability.

The materials available were well known from observations of the fills and slopes over a period of years.

The contractor compacts the fill with a few passes of a 4-drum tandem sheepsfoot roller followed by two 10-ton three-wheel rollers. The soil is placed in 4-in. layers directly from the cut by tractors and scrapers or power shovel and trucks. Whenever the poorer soils are encountered they are mixed on the fill with those of better quality. Even though the ground is quite hard and dry at times, no sprinkling is done or is required. Test cores are taken occasionally to check the moisture content even though no attempt is made to control it. There are a variety of soils along this stretch of road with clay and gravel predominating. Some clays; clay-loams; sandy loam; shale strata, and mixtures of all kinds inter-



Part of the Job (at the Lower End of Sodus Bay) Was Very Soft and Mucky. Note the Mucky Condition of the Soil. The Water Was Seeping into the Ditch Immediately Behind the Scraper. The Cut Would Shake and Quiver as the Scraper Bit Was Pulled Through It.



Variable Soil Types Required Close Attention of the Inspector to Obtain Uniformity in Fills.

so that the paving work might be expedited. The specifications place this work in the hands of the engineers in charge, to be done "as directed by" and in a manner "satisfactory to" the engineers.

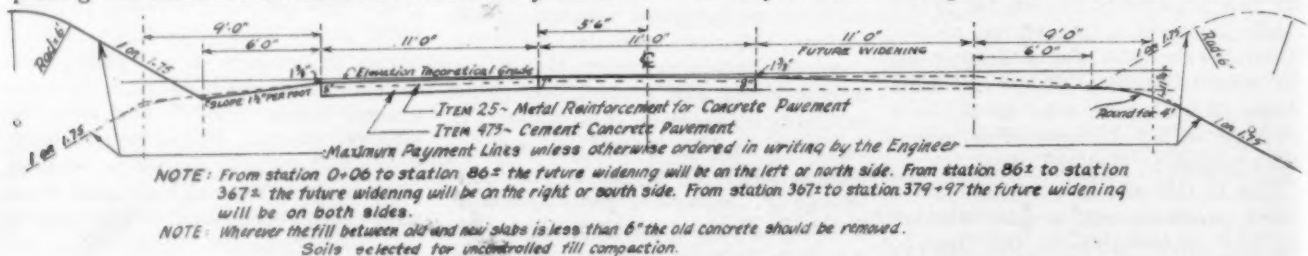
Before a contractor can bid on such an open specification there must be some agreement as to what is to be expected. In this case the compaction work was bid as a part of the cost per cubic yard of excavation and the equipment to be used and the method of compaction were agreed upon prior to taking bids.

Soil surveys were not employed, the state relying upon the experience, skill and judgment of its engineers in placing the materials at hand in a satisfactory manner.

spersed with small boulders, typical of the glacial deposits of this area, are also found.

Jacobson and McKinley of Pittsburgh, Pa., are subcontractors on the grading. They are using four 12-yd. Heil scrapers pulled by Cletrac 80's; one 12-yd. Le Tourneau is pulled by a Caterpillar RD 8. An Allis-Chalmers LO equipped with a Baker bulldozer has a homemade pushing block attached on the front of the bulldozer. The 10-ton 3-wheeled Galion and 10-ton 3-wheeled Buffalo-Springfield rollers compact the layers after the sheepsfoot rollers pass over them.

The grading operations have been proceeding at the rate of 70 to 80 thousand yards per month and will soon be ready to receive the pavement. Two slabs of a three-



Typical Cross-Section of Alton-Wolcott Road.



Digging in a Seam of Hard Shale Interspersed With Rock the Size of a Football. A Pusher Is Needed to Get a Full Load.

lane highway will be laid. These slabs are of reinforced concrete, 7 in. at the center increasing uniformly in thickness to 8 in. at the edges. The shoulders will be built up so that the pavement rests in a trench section. Shoulders and backslopes will be well rounded to improve the appearance and will be seeded or sodded as deemed necessary. The cross-section, in the accompanying diagram, shows the design of this road. The job is seven miles long and located about 42 miles east of Rochester, N. Y.



Clay Topsoil Loads Easily and Is Mixed on the Fill With Shaley Material.



General View of Fill Compaction and Equipment.

QUANTITIES AND PRICES

NO.	ITEM	UNIT	QUANTITY	PRICE	AMOUNT
1	Clearing and grubbing	l.s.	Neces.	\$550.00	\$ 550.00
4C	Unclassified excavation	c.y.	370,000	.20	74,000.00
5	Trench, culvert and bridge excav.....	c.y.	4,095	.80	3,276.00
7	Trimming shoulders	l.f.	38,470	.10	3,847.00
8	Preparing fine grade	s.y.	96,375	.10	9,637.50
10A	Pipe underdrain, 4 in. diam.	l.f.	1,100	.20	220.00
10B	Pipe underdrain, 6 in. diam.	l.f.	3,600	.25	900.00
S13A	Cast iron pipe, 16 in. diam.	l.f.	124	2.50	310.00
S 13B	Cast iron pipe, 20 in. diam.	l.f.	244	4.00	976.00
S 13C	Cast iron pipe, 30 in. diam.	l.f.	492	8.80	4,329.60
15C	Portland cement...	bbl.	30,670	2.00	61,340.00
15M	Natural cement...	bbl.	4,975	2.20	10,505.00
16	Conc. for structures, 1-2-3½.....	c.y.	887	21.00	18,627.00
20	First-class conc., 1-2-4	c.y.	85	20.00	1,700.00
21	Second class conc., 1-2½-5	c.y.	337	16.00	5,392.00
24A	Loose stone backing	c.y.	152	4.00	608.00
25	Metal reinf. for conc. pav't.....	s.y.	90,630	.22	19,938.60
25S	Steel fabric reinf. for conc. pav't....	s.y.	45	.25	11.25
25X	Extra metal reinf. for conc. pav't...	s.y.	200	.25	50.00
27	Joint supports	each	10,300	.45	4,635.00
28	Bar reinf. for structures	lbs.	73,600	.06	4,416.00
33R	Cable guard railing	l.f.	15,910	.80	12,928.00
34C	Guide posts	each	490	2.30	1,127.00
39	Foundation course, R.O.B. gravel....	c.y.	2,000	1.00	2,000.00
41BT	Found. course, broken stone, L.M....	c.y.	1,070	3.00	3,210.00
45A	Bottom course, broken stone	c.y.	855	3.00	2,565.00
47S	Cement conc. pav't	c.y.	18,895	4.25	80,303.75
R 53T	Top course, bit. mac. M.M. 3.....	ton	575	6.00	3,450.00
61	Bit. mat. waterproofing	gal.	850	.70	595.00
76	Maint. traffic at culverts	l.s.	Neces.	600.00	600.00
77	Maintaining traffic	l.f.	72,125	.05	3,606.25
77A	Maint. traffic for bit. macadam.....	l.f.	1,665	.10	166.50
77P	Protec. of traffic..	l.s.	Neces.	1,800.00	1,800.00
80	Dry rip-rap	c.y.	15	4.00	60.00
82	Cofferdams, pump, bail and drain....	l.s.	Neces.	500.00	500.00
93	Broken stone loose measure	c.y.	1,530	3.00	4,590.00
98S	Concrete gutters..	s.y.	650	1.80	1,170.00
104	Conc. right of way markers	each	164	2.00	328.00
107	Timber and lumber MFBM		4	60.00	240.00
109	Relaying old pipe..	l.f.	400	.25	100.00
110W	Topsoil	c.y.	10,100	.80	8,080.00
114	Seeding	s.y.	81,000	.03	2,430.00
116	Sod	s.y.	9,200	.40	3,680.00
121	Drilling and grouting	l.f.	25	1.25	31.25
122	Cut keyway and remove existing parapet	c.f.	75	.40	30.00
127	Metal reinf. for culverts	s.f.	130	.20	26.00
142	Gravel surfacing..	c.y.	270	1.50	405.00
215	Fertilizer	lb.	240	.025	6.00
222	Ulmus Americana	each	26	3.40	88.40
223	Acer Saccharum..	each	30	3.75	112.50
224	Salix alba.....	each	4	2.90	11.60

Total contract \$364,259.20

The contract is being carried out under the direction of District Engineer William Robinson, Supervising Engineer Charles Fischer, County Assistant R. J. Storm with R. S. Pollard, Engineer-in-charge. Warren Brothers Roads Company, Boston, Mass., is the general contractor and is doing the paving work.

Conclusions.—Selected soil materials will certainly be an added advantage to the fill construction. There is no doubt but that this project should be watched for three or four years for settlement effects in order to learn whether or not sufficient control was employed in the embankment construction. That part of the state suffered from a long dry spell, consequently the natural moisture content was below normal.

STABILIZATION—PETROLITHIC COMPARISON

One of our readers, in a spare moment, after reading Mr. Hughes' (Utah) article in the June issue of *ROADS AND STREETS*, jotted down the following interesting comparison between the described general practice relating to soil stabilization and the procedure for construction of the petrolithic earth road:

<i>Present day soil stabilization practice</i>	<i>Petrolithic earth road construction as described by Hubbard</i>
1. Subgrade scarified to the specified depth.	The road is plowed up to a depth of six inches. All lumps are thoroughly broken up by means of a harrow.
2. The soil is wetted with water to approximately the optimum moisture content.	The roadway is well sprinkled with water.
3. Bitumen is added and thoroughly mixed with the soil until a uniform mix is obtained.	After compacting the loose earth from the bottom up to a depth of 2 inches, bitumen is applied and a cultivator passed over the road until the oil and earth are thoroughly mixed.
4. The mixture is laid down and compacted, generally, with sheep-foot type tamper.	The sheep's foot tamper is used to compact the road until one and one-half inches of loose material remain on top.
5. After initial compaction, the entire road bed is bladed with a motor grader or maintainer to a uniform cross section.	The road is lightly harrowed and sufficient water added to moisten it. A light application of oil is given.
6. The road is finally compacted with a 5-7 ton roller.	The surface is rolled with a sheep-foot roller until firm, and finally ironed down with an ordinary roller.

The question arises as to why the construction procedure prior to 1910 did not meet with the success that soil stabilization is evidently now attaining.

Provide your own answer. We believe the answer is quite evident.

IRON PAVEMENT PATENTS

To the Editor:

In connection with the article on page 70 of the July issue, relating to a cast iron pavement to be built in Minnesota, I have noted that some of the earliest patents on pavements in this country dealt with iron pavements. I have a photostatic copy of the list of patents issued from 1790 to 1873 on pavements, and note the following:

Iron Pavement—G. W. Bishop.....	1857
C. Mettam	1857
R. Montgomery	1858
J. Montgomery	1859
A. R. Tewkesbury.....	1858
Metallic Pavements—S. B. Ellithrop.....	1856
J. Dean	1867
J. B. Tarr.....	1867
S. D. Tillman.....	1870
George W. Eckert, Research Chemist, Missouri State Highway Dept.	

TRANS-ANDEAN HIGHWAY TUNNEL

It is reported that the railway tunnel through the Andes connecting Argentina to Chile will be reconditioned to permit the passage of automobile traffic. The National Highway Commission states that there is sufficient room on one side of the railway tracks for the construction of a narrow highway which can be paved at a relatively low cost. Present plans call for the inauguration of this work in the near future, and it is expected that it can be completed by the end of this year. Transit over the Andes is now suspended for about seven months of the year on account of the passes being blocked by heavy snowdrifts. With the completion of the reconditioning of the railway tunnel, communication with Chile by automobile will be possible for nine months of the year.

The projected provisional highway tunnel will be used until the proposed 8 kilometer tunnel through the Andes is constructed to form a part of the Pan-American Highway.

LONG AND SHORT TRUCKING OPERATIONS SHOW WIDE CONTRASTS

Wide contrasts are shown in motor trucking operations, with most truck runs relatively short, but major mileages returned by trucks in long-haul duty.

Local service accounts for a high percentage of motor truck trips, as shown by sample studies in eleven states, based on road use interviews sponsored by the U. S. Bureau of Public Roads in statewide highway planning surveys. These studies, according to the Automobile Manufacturers Association, show that more than 80 per cent of all one-way truck trips extended less than 20 miles. Also, they accounted for less than 34 per cent of the total truck mileage reported.

By contrast, only 6.4 per cent of all trips recorded were 50 to 500 miles in length, but they accounted for 41.2 per cent of total vehicle mileage. Large proportions of livestock, fruit and vegetable shipments are sent over the highway by direct shipment on long hauls, because of their perishable character.

*A Street Which Has Been Resurfaced
With Natural Sandstone Rock Asphalt.*



RESURFACING WITH NATURAL SANDSTONE ROCK ASPHALT

An Outline of Practice and Experience in Indiana

By N. F. SCHAFER
*Engineer of Maintenance,
State Highway Commission
of Indiana*

ON JANUARY 1, 1938, the State Highway Commission of Indiana was mandated by the State Legislature to maintain, construct, and reconstruct all State Roads inside cities except first class. Many of these streets were approaching failure or were unsatisfactory for present day traffic because of roughness. Many state road surfaces were in a condition similar to these city streets. These surfaces included cement concrete, bituminous concrete, sheet asphalt, bituminous asphalt, etc. It was thought that the policy of resurfacing or "reroofing" would be wise because it would save the investment which had already been made to construct the roads or streets and a good serviceable riding surface could be secured. In this salvage work only pavements with satisfactory alignment, grades and adequate bases were considered.

Past methods, also many years of construction and



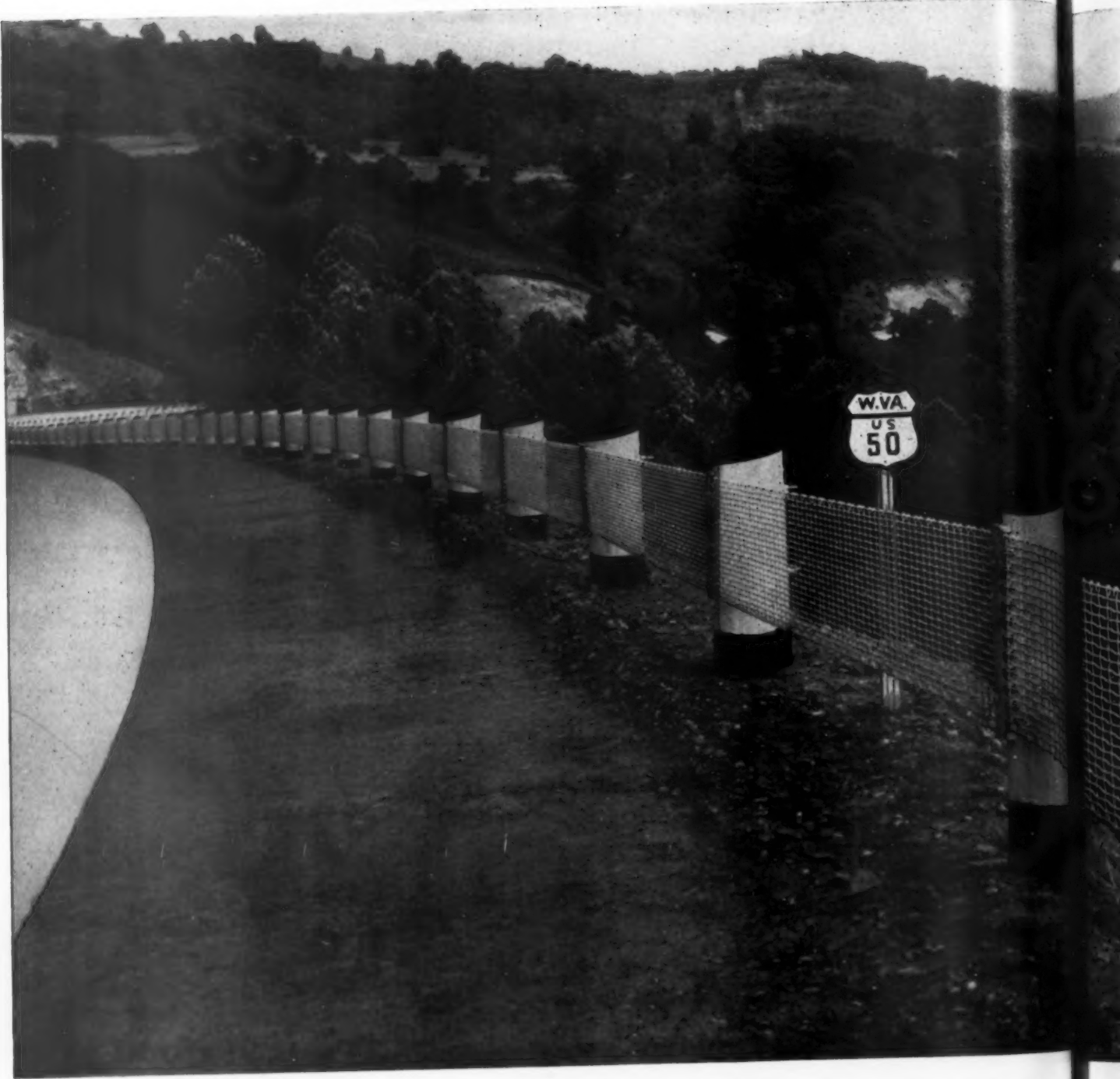
Drag Type Bituminous Surface Treatment in Progress.



*A Resurface Job Nearing Completion.
Finished Rock Asphalt Surface at Right; Binder Course Primed
and Ready for Surface at Left.*

maintenance costs, were studied. These studies proved that it would be most satisfactory to apply either a plant or road mix type of bituminous binder to the present bases, and to this an application of natural sandstone rock asphalt. The binder would level up the old base and the rock asphalt would provide a good, non-skid wearing surface. This same method has been used for many years and found to be satisfactory.

A rough or failing surface, which has sufficient base for the traffic load, good alignment, and grades, may easily be modernized by adding a binder and wearing surface. Before the binder was applied, the base was patched with a plant mixed material. From this point two methods were used. A surface which was exceed-



Beautiful... Effective



Pittsburgh *Safety*



HIGHWAY GUARD

PITTSBURGH STEEL COMPANY, GRANT BLDG., PITTSBURGH, PA.



Finishing Machine at Work on a Rock Asphalt Surface.

ingly rough received a drag road mixed treatment of liquid asphalt RC-3 or emulsified asphalt AES-3 in an amount from 0.4 to 0.6 gallons per square yard of surface and from 40 pounds to 60 pounds of one half inch to No. 8 clean aggregate. The aggregate and bituminous material were mixed and spread with long base maintainers or retread pavers. The long base equipment permitted a greater amount of material to be deposited in the low places and a lesser amount on the high places, thus providing the first step in the leveling process. This treatment was rolled with 10-ton rollers and permitted to cure.

For surfaces which were not exceedingly rough the above treatment was eliminated. On these surfaces and those which had been treated, a plant mix binder was applied. A prime which consisted of from 0.1 to 0.15 gallon of liquid asphalt RC-1 or emulsified asphalt AES-2 per square yard of surface was applied to this base. Two types of plant mix binder were used: Bituminous Coated Aggregate (emulsified asphalt or liquid asphalt) or Bituminous Concrete AH (hot mixed hot laid). The bituminous coated aggregate mixture was composed of aggregate (from $\frac{3}{4}$ in. to the No. 8 screen) and 3% to 5% of bituminous material, by extraction, while the bituminous concrete mixture was composed of aggregate (from 1 in. to the No. 200 screen) and 4% to 6% of 50 to 60 penetration asphalt.

The bituminous mixture was hauled to the job in trucks and dumped into mechanical finishing machines. After the finisher had spread the mixture, it was thoroughly rolled. The bituminous coated aggregate was sealed by applying 0.15 gallons of liquid asphalt RC-3 and approximately 10 pounds of chips (from No. 4 to No. 100 screen) per square yard of surface. These chips were broomed into the voids and rolled. Both types of



Finishing Machine at Work on a Rock Asphalt Surface. The View Shows a Truck Dumping Into the Paver's Hopper.

binder were permitted to cure and opened to traffic.

The application of a natural sandstone rock asphalt wearing surface was done by contract. In May, 1939, ten contracts were awarded for applying this type of surface to 108 locations, of which 72 were in 41 cities and the balance were on roads outside cities. A minimum application of 200 tons of rock asphalt per day was



Steam Jetting Rock Asphalt in Car.

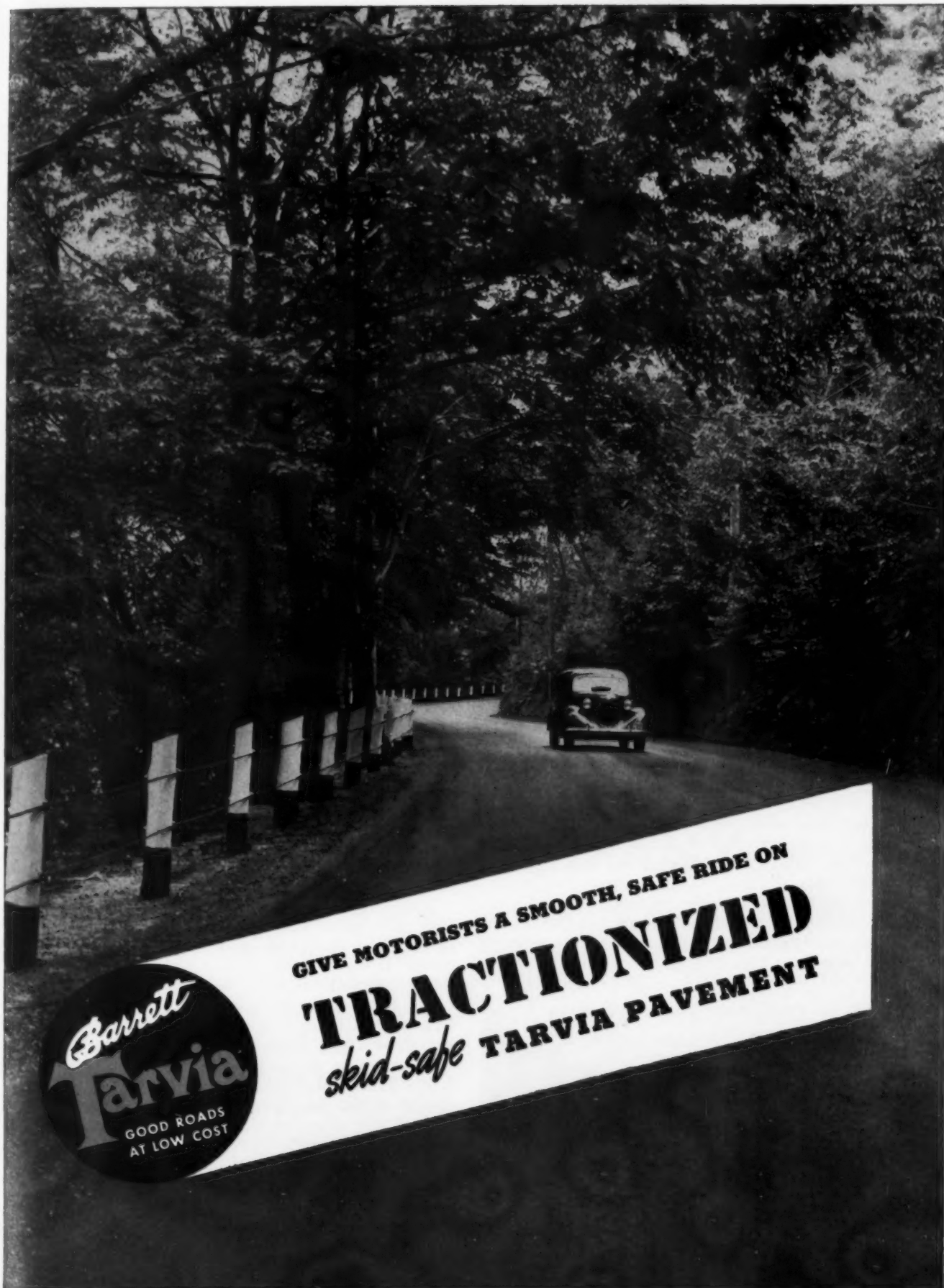


A Rock Asphalt Heating Plant.

Note the arrangement of insulated steam risers from which the jet connections lead.

required and all the work was to be completed by September 1, 1939.

Before the rock asphalt was laid, the base was primed with liquid asphalt RC-1 or emulsified asphalt AE-150 in an amount of approximately 0.05 gallon per square yard. This prime was applied the day preceding the laying of rock asphalt.



GIVE MOTORISTS A SMOOTH, SAFE RIDE ON

TRACTIONIZED

skid-safe TARVIA PAVEMENT

Barrett
Tarvia
GOOD ROADS
AT LOW COST

THE BARRETT COMPANY New York Chicago Birmingham St. Louis Detroit Philadelphia Boston Minneapolis Lebanon
 Cleveland Rochester Baltimore Providence Columbus Toledo Youngstown Syracuse Hartford Buffalo Cincinnati
 Bethlehem Portland, Me. Norwood, N. Y. In Canada: THE BARRETT COMPANY, LTD. Montreal Toronto Winnipeg Vancouver



Luting Edges of Freshly Laid Surface.

The rock asphalt is spread right up to curb face, but is unfinished for a width of 2 or 3 inches from it. The luter spreads the material evenly, removes any excess, and leaves the surface ready for rolling.

The rock asphalt was heated in freight cars by injecting dry steam into the material. When the material had been heated to approximately 200° F. it was removed by means of a clam shell and hauled to the job in trucks. The rock asphalt was at least 175° F. when dumped into the mechanical finishing machine for spreading. Some contractors have spread as much as 600 tons of rock asphalt in a single day. That rock asphalt which was spread before noon was rolled in the afternoon with a 5-7 ton roller and that which was spread in the afternoon was rolled when the temperature was satisfactory the following morning. Any tears or irregularities were repaired after which the surface was given a final rolling with a ten-ton three-wheel roller. The material was permitted to cure for seven days after it had been spread, and then opened to traffic.

After the surface has cured sufficiently, a center line is applied. This 4-inch center line is made by applying liquid asphalt RC-3 to the surface and immediately covering it with fine stone chips, then rolling. This center line embeds itself into the rock asphalt, is light colored and non-skid. The average life of this type of center line is four years.

Resurfacing has proved very satisfactory, not only because of the reasons set out above, but also because the roads and streets are kept closed to traffic a minimum length of time for a high type improvement.



A State Road Which Has Been Resurfaced With Natural Sandstone Rock Asphalt.

Warnings Issued

Warnings were issued by Federal Works Administrator John M. Carmody that certain PWA projects were behind schedule. Among those listed were the following which are projects that would be constructed by highway contractors:

REGION 1

Location	Docket No.	Project	Grant	Estimated Cost
Southbury, Conn.	1004	Misc. impvts.	\$2,488,080	\$ 5,529,066
Havre de Grace, Md.	1139-1	Hgwy. bridge	2,166,000	4,815,000
Charles Co., Md.	1139-2	Hgwy. bridge	1,766,700	3,926,000
Rumson, N. J.	1322	Bridge	513,000	1,140,000
New York City, N. Y.	1402	Grade crossing	961,200	2,136,000
New York City, N. Y.	1816	Street impvts.	4,794,750	10,655,000
Pittsburgh, Pa.	2091	Hgwy. bridges	1,322,415	2,938,700
Woodbridge and Sayreville, N. J.	1331	Bridge	2,113,200	4,696,000
Pittsburgh, Pa.	2193	Streets	790,958	1,757,685
Portsmouth, N. H.	1037	Bridge	1,309,090	2,909,090

REGION 2

Chicago, Ill.	1716	Bridge and gr. separation	777,272	1,727,372
Lorain, Ohio	1652	Bridge	614,052	1,364,560
Lorain, Ohio	1653	Bridge	615,780	1,368,400
Youngstown, Ohio	1827	Street imprv.	1,387,588	3,083,530
Charlestown, W. Va.	1150	Street imprv.	562,909	1,250,909

REGION 3

Birmingham, Ala.	1315	Streets	685,937	1,523,104
Mobile, Ala.	1441	Tunnel	1,500,000	4,000,000
Owensboro, Ky.	6542	Bridge	1,033,807	2,297,350
Natchez, Miss.	1126	Bridge	1,852,358	4,116,350
Greenville, Miss.	1273	Bridge	2,001,150	4,447,000

REGION 6

Los Angeles, Calif.	1644	Street imp.	2,215,350	4,923,000
Los Angeles, Calif.	1708	Street imp.	1,709,685	3,799,302

REGION 7

Seattle, Wash.	1605	Bridge imp.	450,000	1,000,000
King County, Wash.	1180	Bridge	3,794,400	8,432,000

METHUSELAH OF TRUCKS CELEBRATES 24 YEARS OF SERVICE

Talk about long life! Well, here's the grand daddy of them all—a 1915 Mack truck still on the job every day after 24 years of continuous service.

During all this time the truck has been in the service of the same owner, John H. Foley & Son, of Utica, N. Y., whose business is the drilling of water wells throughout the upper part of New York State.

According to Mr. Foley the old veteran totes a daily load of 5 tons of tools, pipe and other well drilling apparatus, and into the bargain pulls a 7-ton drilling machine. It travels over all kinds of back roads in all seasons of the year and frequently hauls through open fields.

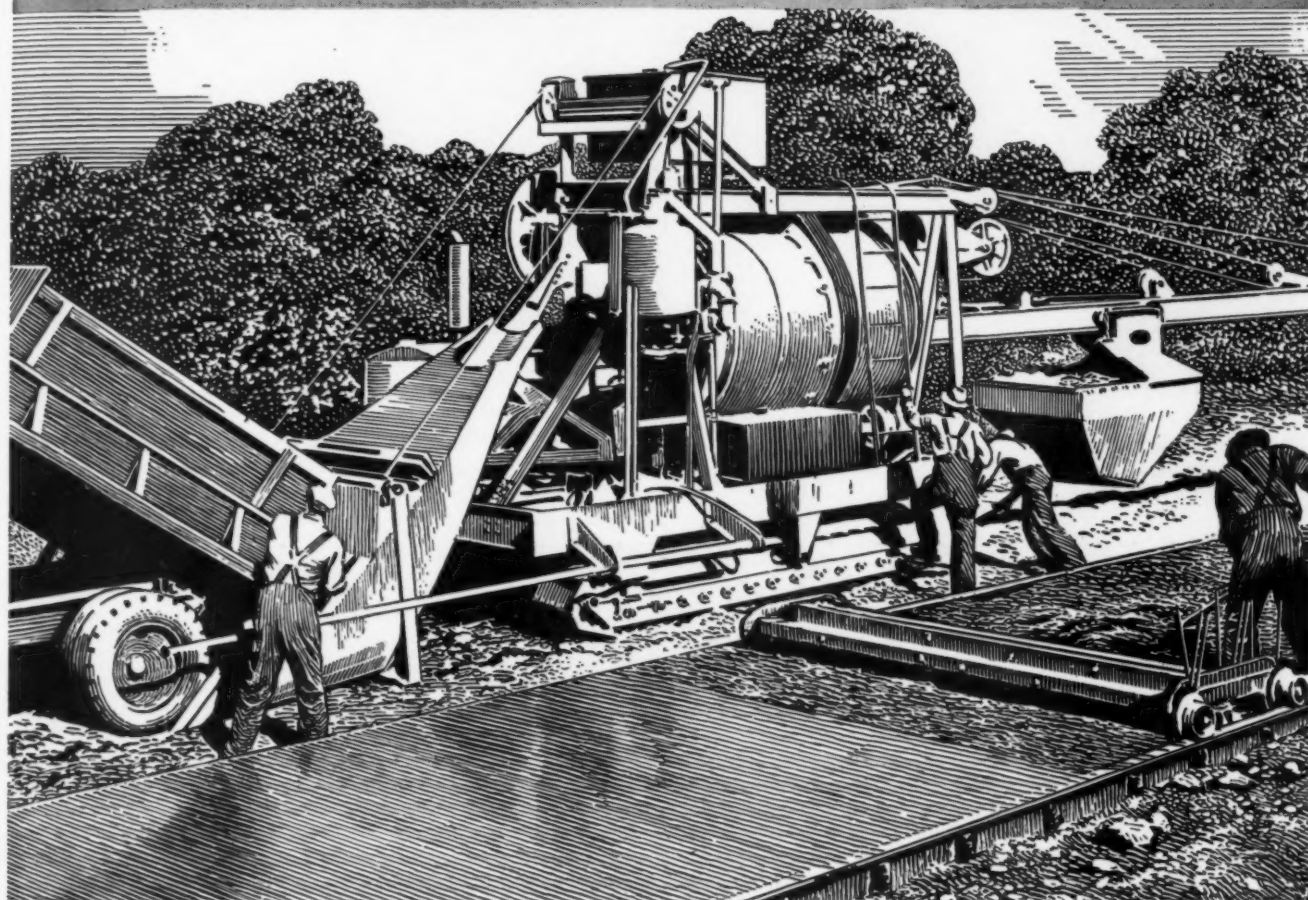
Mr. Foley states that despite its advanced age the old-timer is still as spry as ever and has had surprisingly few repairs.

A search of the archives of the Mack-International Motor Truck Corporation reveals that the following parts of this truck, which incidentally have never required replacement, were forged from a 3½% nickel steel:

- Crankshaft
- Connecting rod
- Differential Bevel Pinion
- Main Drive Bevel Pinion
- Main Drive Bevel Gear
- Right and left hand countershaft
- Rear axle
- Front axle
- Steering knuckles.

This interesting account is quoted from the August issue of *Nickel Steel Topics*.

Good Mixers



IN ANY COMPANY

While men may be known by the company they keep, Hyatts are known by the equipment they help keep running. In mine and factory, on the farm, on railways and highways—everywhere—Hyatt Roller Bearings serve and save. For nearly fifty years these dependable bearings have helped make machinery operate more

accurately, efficiently and enduringly. Get better acquainted with these better bearings. You'll find them good mixers in any company—on any job—at any time. // Hyatt Bearings Division, General Motors Sales Corporation, Harrison, New Jersey; Chicago, Pittsburgh, Detroit and San Francisco.

HYATT *Roller* BEARINGS



The Procession of Finishing Machines

At Left, the A. W. French, Doing Strikeoff and Primary Finish Work; Center, Blaw-Knox Gas-Electric Completing Transverse Finishing; at Right, the Koehring Longitudinal Finisher. In Front, Note Man with Electric Vibrator Working Next to Form, and at Extreme Left, the Projecting Tip of Mixer Boom.

A WELL-CONDUCTED CONCRETE JOB IN ILLINOIS

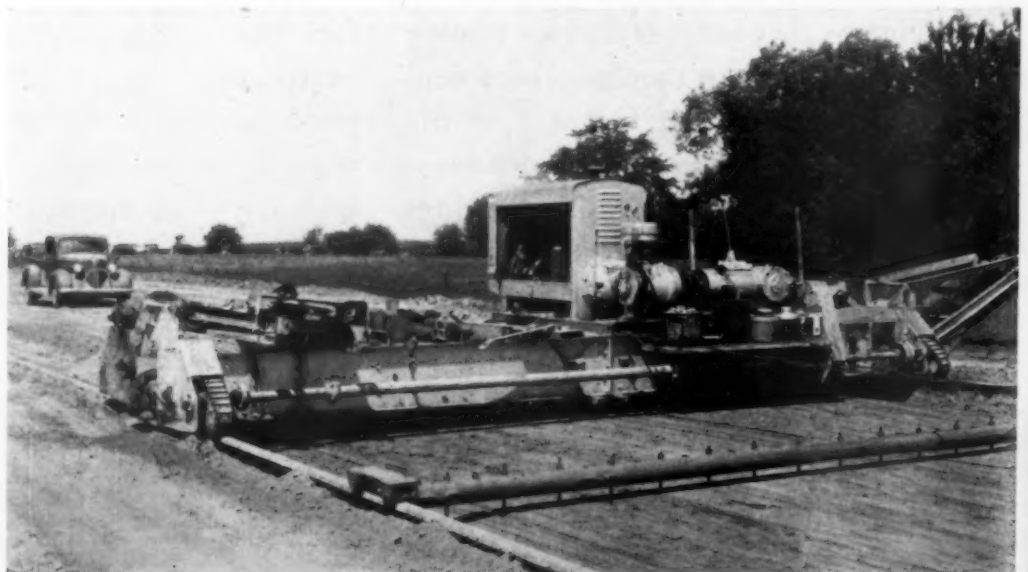
Modern Equipment—Skilled Workmen—Superior Results

DURING the months of July and August of this year, a stretch of 7.06 miles of concrete slab was completed on Illinois Route 89 B between Lasant on U. S. Route 51 and State Route 89. Midwest Construction Company, of Chicago, was the contractor. The job is here briefly described as an example of good workmanship and superior results. A drive over some 4

miles, which was open to traffic, indicated unusual smoothness.

Good workmanship being a pretty general indicator of other merits, the writer was not surprised to find a well organized, well equipped, and efficiently managed job. Not that everything was perfect, or the running always smooth (on the latter point, note the undignified pose of a

Subgrade Finishing with Flynn Surgrader. Material Trimmed from the Surface Is Deposited on Shoulder at right. The Template Is Towed by a Wire at Each End.



THIS HAPPENS *ONLY* IN A FACTORY

Mack



ABOVE, you see the exclusive, patented process of graduated heat treatment, which gives Mack axle shafts extraordinary strength and toughness.

THROUGH many exclusive processes of manufacturing and methods of testing, it is made certain that every Mack part and every complete Mack provide the most dependable, most economical hauling job money can buy. Through 39 years of specialization, Mack has held to a policy of rigid control of quality—right from the selection of raw materials. This control is maintained through the largest research and engineering facilities ever devoted exclusively to truck manufacture.

MACK TRUCKS, INC.

NEW YORK, N. Y.

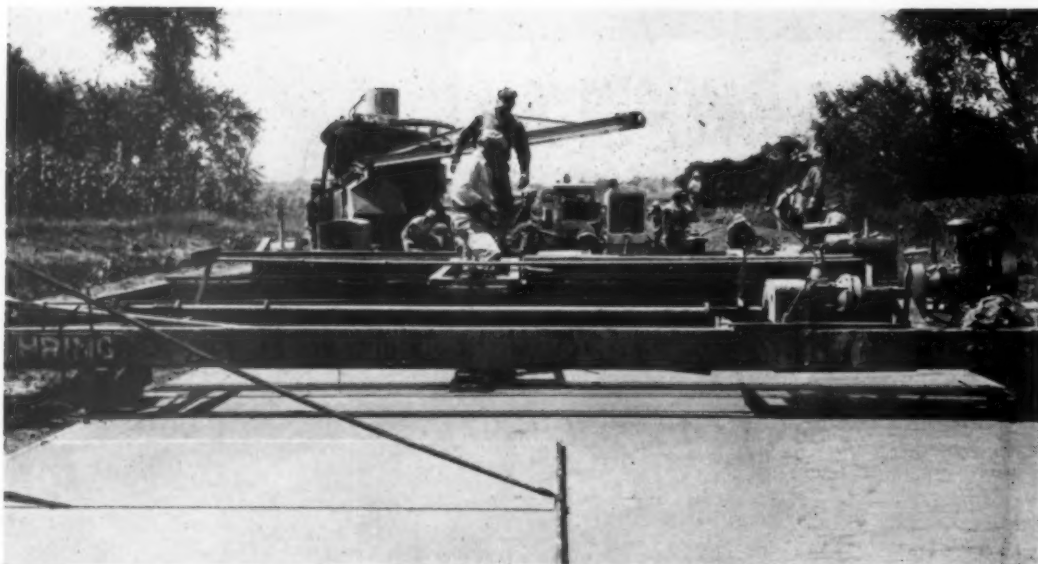
LOWEST-PRICED MACK! At upper left, the new Mack ED, 8,500 lbs. gross vehicle weight, priced at \$675.00, for standard chassis f.o.b. Allentown, Pa. Cab, body and taxes extra.

AT LOWER LEFT, Mack Model BX—one of the big Macks for use in the heavy hauling field.



Mack

THE MOST COMPLETE LINE OF TRUCKS IN THE WORLD...1 TO 30 TONS



A View of Operations from the Finishers' Bridge. In Foreground, the Longitudinal Finisher, or Mechanical Bull Float; Next, the Second of the Transverse Finishers; Beyond That the First, or Rough Finisher; and in Background, the Mixer. The Lute, Though Not Invited Into the Picture, Was Welcome.

batch truck in accompanying photo), but simply that it was an example of superior construction operations.

General Characteristics

Alignment is straight; the grade nearly flat except for a short stretch of 3% at the western end; the roadbed 40 ft. wide. Due to the rolling topography, there was some fairly heavy fill—largely borrow. Side slopes are mainly 3 to 1, with a little 2 to 1 where fill is the highest. The bulk of the material was sandy clay. In a few places the earlier gravel road surface was practically at subgrade elevation, and was useful accordingly. The slab is a typical 9-6½-9 section, 20 ft. wide, mesh reinforced, with dummy center joint and one expansion joint and two contraction joints in each 100-ft. length. It is laid directly on the subgrade, without paper. Subgrade was sprinkled immediately before pouring. Cement ratio was approximately 1.46, with materials and mix all in accordance with Illinois State Standards.

Subgrade Finishing

The first fining operation was to trim with a Caterpillar No. 11 Auto Patrol, leaving the subgrade approximately true in shape, but slightly high to permit a machine finish. Final consolidation was made with an Austin Bull Pup. A new model Flynn Surgrader (Flynn Manufacturing Co., Alexandria, Louisiana) traveling on

the pavement forms, finished the subgrade with precision which surprised the writer. Adjustment of this machine for crown and thickened edges of the section was particularly striking. The trimmed material, discharged in a windrow on the shoulder, was practically powder. A point gage, or template, towed behind the machine, and clearly shown in the accompanying picture, gave an indication at all times of the accuracy of the work. It was stated that the excess of concrete beyond the neat slab section averaged considerably less than 5%.

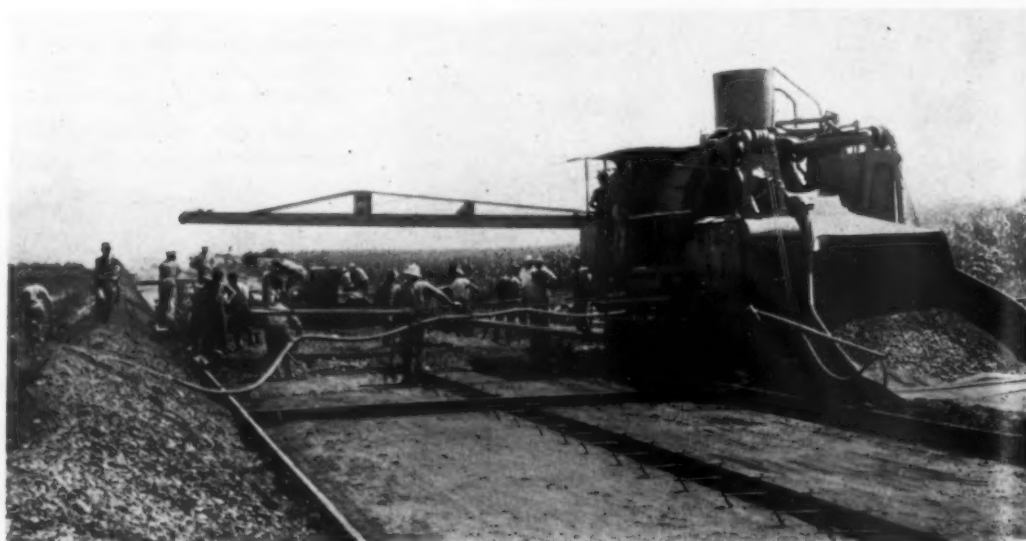
The form cut was made with a Carr Formgrader (Ted Carr & Co., Chicago). Forms were installed well ahead of the final subgrade operation, both Truscon and Blaw-Knox forms being used.

Slab Construction

Concrete was mixed in a Koehring 34-E double drum paver. No attempt was made to work this machine to capacity, but a steady, efficient pace of about 200 ft. per hour was aimed at and generally secured. A single 8-hour shift was worked, and many days produced a total of more than 1600 ft. of 20-ft. slab. Rain during the earlier paving operations caused considerable delay.

Three finishers—two transverse and one longitudinal—were used. First behind the paver was an old model A. W. French, which served mainly for strike-off. Following as closely as operation permitted, came a new

The 34-E Double Drum Koehring Paver at Work. Finishers in Background. Note the Water Line Suspended Over Subgrade. The Berm on Left Shoulder Was Deposited by Subgrade Finisher. Batch Trucks Used the Other Shoulder.



MAINTENANCE EXPENSE OF PRINCIPAL TYPES OF STREET PAVEMENTS IN RICHMOND, VIRGINIA

From Annual Reports of the Director of Public Works for 1936, 1937 and 1938

Item	Year	Vitrified Brick	Type A	Type B	Type C	Type D
Total Square Yards	1936 1937 1938	282,726 291,285 308,166	1,237,256 1,255,413 1,321,786	72,137 72,137 72,137	180,984 182,413 195,754	42,446 42,446 43,225
Square Yards Replaced	1936 1937 1938	16 6 9	33,487 5,650 6,201		2 60 72	3,951 1,365 1,147
Total Maintenance Cost	1936 1937 1938	\$23.47 19.13 28.89	\$40,505.67 15,298.38 16,028.04	\$4.46 272.87 310.88	\$8,383.54 4,358.80 3,969.65	\$258.83 144.89 0
Unit Maintenance Cost Per Square Yard	1936 1937 1938	\$0.000083 0.000066 0.000094	\$0.033 0.012 0.012	\$0.000062 0.0038 0.0044	\$0.046 0.024 0.0203	\$0.0061 0.0034 0
Maintenance Cost Per Square Yard	3 Year Ave.	\$0.000081*	\$0.019	\$0.0027	\$0.030	\$0.0032
Comparative Index	3 Year Ave.		1	247	33	370

NOTE—Surface Courses on Concrete Bases.

*Maintenance due to causes other than the failure of the Vitrified Brick.

"BOX-CAR DECIMALS" used to give square yard maintenance cost of Brick.

Photo is South 2nd Street, Richmond, Va.

Three-year Maintenance Costs at Richmond, Va.

Brick was $\frac{1}{370}$ th that of another well-known type



CASE HISTORIES are always interesting. They are devoid of generalities. And the 3-year case history of maintenance costs of various pavement types at Richmond, Va. is especially so.

Other pavement types were found to cost from 33 to 370 times as much per square yard to maintain as brick.

Look at that "box-car" decimal that is used to give a unit maintenance cost for brick—four ciphers between the decimal point and the first figure!

But this is only a portion of brick's amazing economy. Its useful life goes on and on—often 35

years, sometimes 50 years or more. In recent years more improvements have been made in the manufacture and construction technique of brick pavements than in all of the centuries of its use.

Engineers can simplify their work—make startling reductions in "pavement cost per year" by resurfacing failing pavements with brick and protecting new construction with a modern brick surface.

For further information, write National Paving Brick Association, National Press Building, Washington, D. C.

BRICK

FOR NEW AND RESURFACE JOBS

Blaw-Knox gas-electric to complete transverse finishing, and immediately after that, a Koehring longitudinal finisher. This three-machine combination made beautifully steady progress, and was the primary factor in producing the exceptional surface, credit, of course, being due likewise to capable operation.

A part of the work in which entire credit for superior results goes to the personnel was in the hand operations—belting, luting, brooming and edge finishing—which followed the machines. All the men engaged on these were of more than average skill—another link in the chain of factors which leads to frank praise of the job as a whole.

Returning for a moment to machine operations, a vibrator made by Electric Tamper and Equipment Company of Ludington, Michigan, was used in accordance with Illinois revised specifications. The power unit for this tool was mounted on the A. W. French finisher, but it may be noted that the Blaw-Knox finisher had special provision for vibrator attachment when necessary or desirable.

For curing, a burlap cover was applied and kept wet for 24 hours, after which it was stripped and calcium chloride applied at a rate of 2 to 2¼ pounds per square yard.

Material Handling and Hauling

Aggregate storage and proportioning plant was on a branch of the New York Central Ry. about 1½ miles from the nearest construction and 5½ miles from the farthest. A peculiar feature was the separation of cement and aggregate plants by nearly ¼ mile, such spacing being due to the use of permanent railroad sidings, which were already in place. Coarse and fine aggregates received in gondolas were stock-piled and put through a Johnson bin and weighers. All aggregate handling was by a Northwest crane with ¾-yard bucket. The plant operated with complete satisfaction, and could have been substantially speeded up if necessary. Bulk cement was used, the cars discharging to a conveyor below the track, from which the cement passed by elevator to a Butler bin and weigher.

Due to labor union restrictions, only 35-cu. ft. batches were used, although the 10% overload provision on the paver would have permitted 37.4 cu. ft. The number of trucks varied from 18 to 30, depending on the length



The Aggregate Plant. Johnson Bin and Weighers. Northwest Crane.

of haul. The majority were old Internationals, though there were also a few new Fords and others. All were of 2-batch size.

As with many jobs of this sort, there were difficulties in keeping hauling adjusted to other operations. Two-batch trucks coming up the roadbed, crossing the form on a timber runway ahead of the subgrade machine, proceeding along the 10-ft. shoulder to the mixer, and returning by the same route, could not supply materials as fast as paver and finishers could handle them. At least one spill over the bank resulted from an attempt at too close passing.

The remedy is not clear. It would hardly be practical to widen the approach to the mixer except over the shallowest of grading. Keeping the subgrade machine closer to the mixer would save a little, but only a little time in getting trucks to position. Three-batch or four-batch trucks would speed work somewhat, but would bring no economy unless the contractor should happen to have them readily available, and might even increase costs. But all this is speculation on a more or less ideal efficiency—a goal to be looked at, but not one to blind anybody to practical accomplishment under existing conditions.

One thing certainly deserving remedy is restriction of output through union rules. Such restriction represents the bad side of union activities, the side against public interest—not the good and necessary side, recognized and welcomed by liberal minded people regardless of their own position.



This Truck Dumped Its Two Batches at an Unscheduled Point. Perhaps They Will Hold the Toe of the Slope in Some Heavy Rain. The Driver Jumped Just in Time.

ROAD COMMISSIONERS CONSTRUCT \$2,000,000 SEWER SYSTEM.—The County Road Commissioners of Wayne County, Michigan, in addition to their other duties are now building intercepting sewers and a sewage disposal system estimated to cost \$2,000,000, of which the county will furnish \$1,100,000 and the Federal Government \$900,000. The work is known as the Wayne County Sewage Disposal Project and it comprises sewage disposal plants and the necessary intercepting and collecting sewers for that part of Wayne County which would not be served by the city of Detroit system or which was not already served by adequate sewage disposal facilities.

NOT UNDER THIS ROAD.



*There won't be any
buried waste profits!*

LOOK at it! Smooth as a whistle! Right to the line! One pass over the rough grade—good-bye grading headache! The R. B. Power Finegrader really rolls out the grade, too—always enough ahead so other equipment can be pushed to the maximum, and that's of real value on these late season contracts.

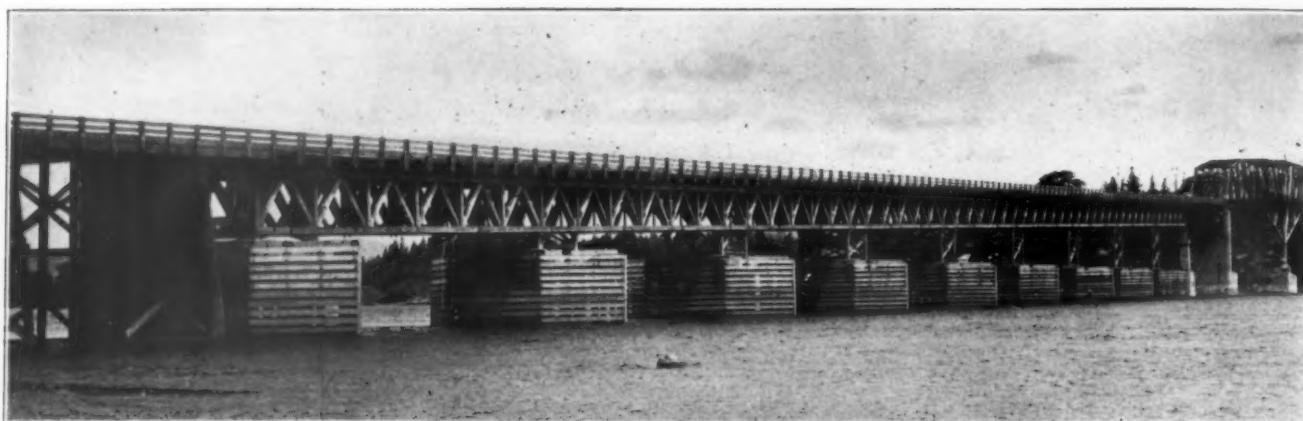
No paver delays, no extra work for the trail grader—and no money lost in extra slab thickness which, according to many state engineers, can run as high as 7%. That's important! And these aren't all the advantages. Before you figure on that next contract let us tell you more about what R. B. can do for you.

What
R. B. FINEGRADERS
will do for you!

- Build a smoother, more accurate finegrade
- Cut the cost of finegrade
- Save concrete
- Increase production
- Always reduce and sometimes eliminate the work of the trail grader where specified
- Reduce paver delays
- Provide better handling of shoulder materials



R. B. EQUIPMENT DIVISION
The BUCKEYE TRACTION DITCHER CO.
228 No. LaSalle St., Chicago, Ill. • FACTORY: Findlay, Ohio



*Up-River Side of the Bridge from Puget Island End.
The Bulkhead Between Truss and Trestle Sections Is a Fire Wall of Wolmanized Lumber.*

TIMBER CONSTRUCTION IN THE PUGET ISLAND-CATHLAMET BRIDGE

THE new Puget Island-Cathlamet highway bridge, stretching for nearly half-a-mile across the Columbia River in Washington, is being completed at a cost of but \$500,000 due largely to the skillful design and construction of its long all-wood approach. It was opened temporarily for dedication in August, but will not be in general service until completion of the approaches, about November first.

Contracts for the bridge were let in three units. The first unit was for foundation piers. The second unit was for the 1,200 lin. ft. of four steel spans over the river channel. The third represents the 1,200 lin. ft. of approach incline on the Puget Island end from low-elevation diked land. At the Cathlamet end no approach was necessary as the high steel spans connect directly with highway No. 12 at that level. The highway runs from Longview-Kelso in Cowlitz County to Pacific Ocean beach resorts in Pacific County.

The all-wood approach consists of 17 timber trestle spans and nine wood truss spans with a total length of 900 ft., and 323 lin. ft. of timber trestle to island shore. The four steel spans have a length of 1,200 ft., the longest cantilever having a 420 ft. horizontal clearance and 60 ft. vertical clearance over high water.

Specifications for Unit No. 2, the center steel spans, called for 200,000 ft. of Wolmanized Douglas fir, most of which was 3 in. x 6 in.—22 ft. select structural laminated decking, on which an asphalt wearing mat was applied. The lumber also included the 7 in. x 8 in. wheel guard and the sidewalk.

Specifications for Unit No. 3 called for 50,000 feet of Douglas fir for sidewalks and 17,000 feet in the trestle bracing. The specifications provided for alternates for the main portion of the approach spans, either (a) 500,000 feet of lumber for an all-wood structure or (b) a steel structure reducing the lumber requirement to 238,000 ft. The low bid on the all-wood alternate, which

was successful, was \$107,000 or \$4,000 less than that of the steel-wood structure.

The wood spans, fabricated by the Arch-Rib Construction Company of Portland, Oregon, are each 12 ft.



*Timber Truss and Pier Details.
Town of Cathlamet in Background.*



ADD AN
Extra Lifetime
TO CONCRETE HIGHWAYS

CONCRETE highways last longer, stay smoother and cost less to maintain when they are reinforced with wire fabric. For the interlaced wires of steel bind the concrete together and help prevent cracking. Should cracks appear, their spreading is definitely retarded by the wire fabric.

Construction men have found that the application of wire fabric is quick, simple and trouble-free. No skilled labor or special tools are

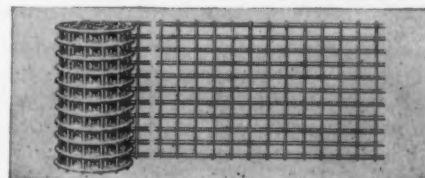
required for installation.

U-S-S WIRE FABRIC is made of high-yield-point cold drawn steel. The wires are closely spaced to provide uniform stress distribution. Available for quick delivery in either sheets or rolls—in Electric Welded Rectangular or Square Mesh and in Triangle Mesh. Write us for further information. Our engineers will be glad to show you how U-S-S Wire Fabric can add an extra lifetime to your concrete highways.



AMERICAN TIGER BRAND
WIRE ROPE

MULTISAFETY
CABLE HIGHWAY GUARD



WIRE FABRIC IN SHEETS OR ROLLS

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York



Columbia Steel Company, San Francisco, Pacific Coast Distributors • United States Steel Products Company, New York, Export Distributors

UNITED STATES STEEL



The Underside of One of the Timber Truss Spans.

high, 4 ft. thick, and 96 ft. long, and weigh about 19 tons. Details were simplified by incorporating Teco split ring and shear plate connectors in the joints, permitting economy in labor costs due to more rapid shop fabrication of all parts, and subsequent assembly following Wolman Salts treatment by the American Lumber & Treating Company. Some 24,000 ring connectors were used.

The eighteen trusses required for the spans were loaded on three barges and floated down the Columbia River to the bridge site. They were attached to eight treated timber towers, of various heights, set on concrete pier bases in the river, and raised into position by means of a derrick on a barge. These towers decrease in height from the four steel spans to the connection of the eighteen wood trusses and the seventeen timber trestle bents at the Puget Island end of the bridge. Floor beams, 12 in. x 24 in.—28 ft. were laid on top of the trusses, eleven to each, connecting across the bridge. Atop these floor beams are laid 3 in. x 6 in. treated bridge decking lengthwise.

The structure was erected by the Washington State Highway Commission with PWA funds. Covering specifications are standard for the Department of Highways and were approved by the U. S. Bureau of Public Roads. The lumber was manufactured by the Crossett Western Co., of Wauna, Oregon, and other sawmills near the bridge site. It was inspected by Pittsburgh Testing Laboratory, each piece being branded by the inspector. Timber connectors were supplied by the Timber Engineering Company of California. Parker-Schram Co., of Portland, Oregon, were contractors. The structure was designed by L. V. Murrow, Director, and R. W. Finke and Clark H. Eldridge, bridge engineers, for the Washington Department of Highways. The accompanying pictures were taken in July, 1939.

The bridge may seem strange to some who remember the old ferry crossing.

Automobile Statistics 1929-1939

Automotive World News, publication of U. S. Bureau of Foreign and Domestic Commerce, in its issue of Aug. 1, heads a variety of interesting and valuable data with the following table:

WORLD REGISTRATION OF MOTOR VEHICLES AS OF JANUARY 1, 1929-1939

Year	United States	Other Countries	World Total
1929.....	24,629,921	7,398,663	32,028,584
1930.....	26,653,450	8,473,948	35,127,398
1931.....	26,697,398	9,108,234	35,805,632
1932.....	25,986,353	9,277,044	35,263,397
1933.....	24,317,020	9,250,275	33,567,295
1934.....	24,057,027	9,505,032	33,562,059
1935.....	25,163,789	10,191,521	35,355,310
1936.....	26,382,321	11,072,488	37,454,809
1937.....	28,520,559	12,039,608	40,560,167
1938.....	30,041,292	13,037,338	43,078,630
1939.....	29,852,910	13,967,019	43,819,929

Diesel Increase

"In the year under review motor vehicle operation in the United States included 25,264,260 passenger cars, 4,427,413 trucks, 156,237 buses, and an estimated 5,000 Diesel units. This compares with 25,449,397 cars, 4,450,507 trucks, including Diesel powered vehicles, and 141,488 buses on January 1, 1938. It will be noted that the number of buses in use registered the only increase during the year. In those countries outside of the United States, the 1938 figures were 9,428,802 passenger cars, 3,198,023 trucks, 323,940 buses, and 86,573 Diesel units, as against the current totals of 10,160,666 passenger cars, 3,409,263 trucks, 267,039 buses, and 130,051 Diesels. Of these vehicles only buses showed a lower total than was recorded a year ago, passenger cars being up by 13 per cent, trucks by 6 per cent, and Diesel units by 50 per cent."

"The growing participation of Diesels reflects the continued experimentation and research that is being carried on by several of the motor vehicle producing nations in an effort to develop a substitute fuel which may be used to replace their limited supplies of gasoline, especially in emergency periods.

"On January 1, 1935, the first year in which the Automotive-Aeronautics Trade Division attempted to separate the registration figures of Diesel units, a total of 37,816 was reported in operation. This number has increased in five years to 135,051, a gain of 257 per cent. While every effort has been made to secure an accurate compilation of these units, it is evident that Diesel use is probably greater, to a considerable degree, than is indicated from the official returns."

Motor Vehicles and Population

If you're planning a trip to Muscat, Arabia, better take your car along, as that country boasts only one automotive vehicle to each 15,152 inhabitants—the lowest rate appearing in a table of 187 nations, subdivisions and colonies. Liberia is next in line, with one to each 12,000. No, we beg your pardon, Greenland has no automobiles.

Australia rates one car, bus or truck to each 9 people, Canada one to 8, New Zealand one to 6, and old Mother England only one to 17.

Russia's ratio is one to 253, China's one to 9,201, Germany's one to 42, France's one to 19, and Japan's one to 388.

Here at home there is an auto to each 4.3 of us; in Alaska, one to each 18; and in Hawaii, one to each 6.



FULTON COUNTY, GA. • PAVED in 1916



LA SALLE COUNTY, ILL. • PAVED in 1914



JACKSON COUNTY, IND. • PAVED in 1914

Unretouched photographs of these old concrete roads show the satisfactory condition of the *original concrete surface* after a quarter century of use.

Old enough to vote and the Original Surfaces are still in good shape!

Only Concrete stays smooth-riding so long at such low annual cost!

There is only one way of calculating the cost of roads that is fair to *you*! In addition to original cost, these factors must be figured in — maintenance expense, length of service and cost of vehicle operation.

The original surfaces of thousands of miles of concrete roads are still giving satisfactory service after twenty or more years of use. Published state highway records, covering 135,000 miles in 21 scattered states, show that concrete costs an average of only \$103 per mile per year for surface maintenance—\$88 to \$465 *less* than other pavements.

You know from your own experience that concrete is better and safer to drive on. That it gives higher visibility at night, and reduces skidding in wet weather or dry. Yet these superior concrete roads actually cost *less to build* than other pavements of equal load-carrying capacity!

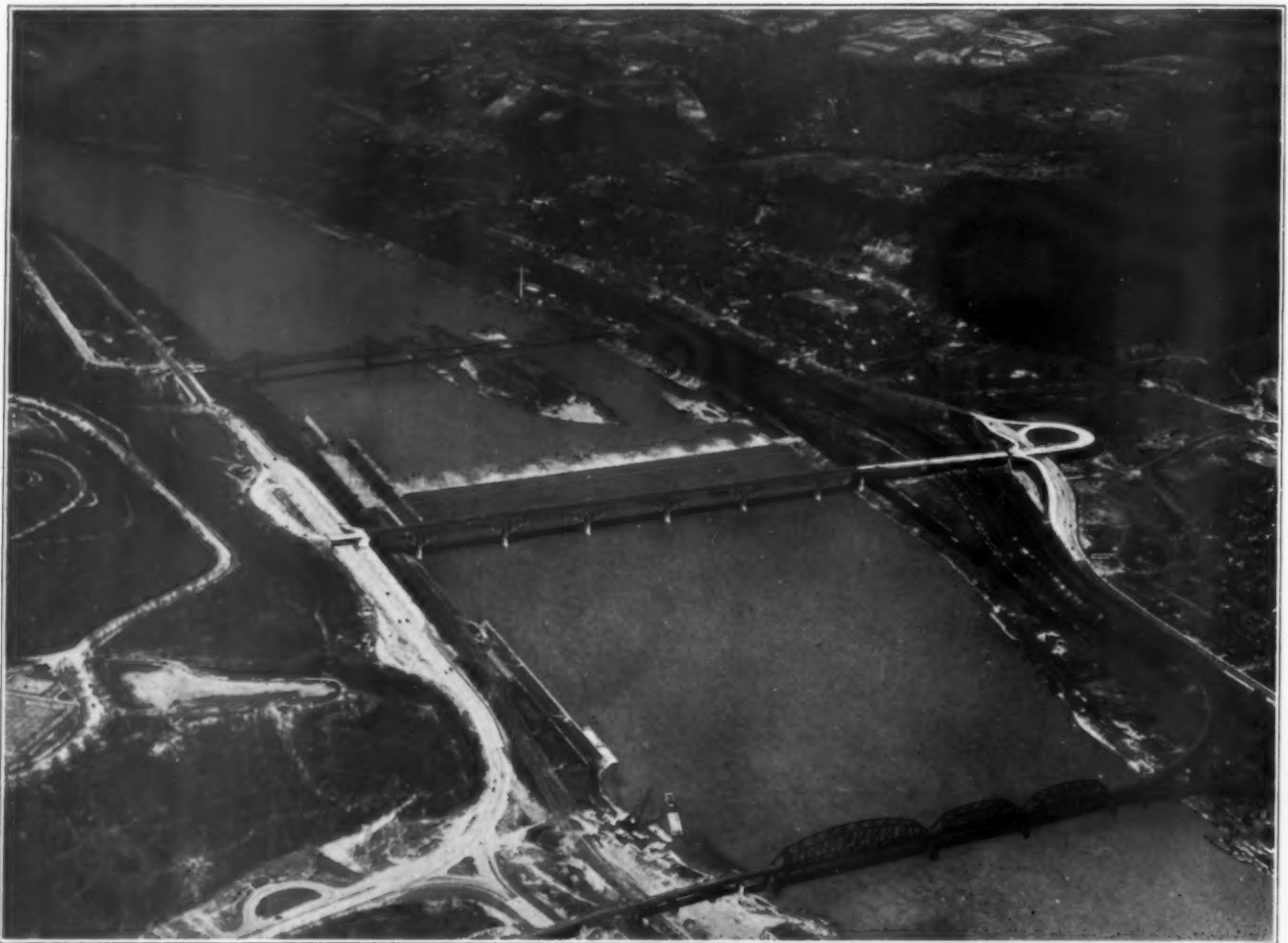
Modern highway systems are built with concrete.

PORTLAND CEMENT ASSOCIATION

Dept. A9-28, 33 W. Grand Ave., Chicago, Ill.

*A National Organization to Improve and
Extend the Uses of Concrete*

Concrete is the Real Low Cost Road



PITTSBURGH'S NEW HIGHLAND PARK BRIDGE AND ITS CONNECTIONS

This picture, taken by President Hubbard of the Meadow Gold Dairy, presents the bridge, its approaches, connections and environs in strikingly clear fashion. A beauty, isn't it? Highland Park lies to the left of the picture. The view is taken looking down Allegheny River toward the city of Pittsburgh.

A. G. C. OF MISSOURI OFFERS SERVICE TO ALL AT LETTINGS

The following announcement was issued August 4 by E. C. L. Wagner, manager, the Associated General Contractors of Missouri, Merchants Bank Bldg., Jefferson, City, Mo.

"At every highway letting, beginning with the letting on August 11, the A. G. C. of Missouri offers the following services to everyone attending the letting:

"*Registration.* We will have a registration desk in the lobby of the Missouri Hotel the night before the letting, where we want everyone to register, including contractors, material men, equipment men, bond and insurance men, etc. Registration card will show your name, your company's name, your line of business and your hotel and room number. We will mimeograph the names and hotel rooms of all persons registered and distribute that list to all. The first edition of that list will be ready at 6:30 and a corrected list will be issued at 9:00 p. m. It will help you to find parties whom you want to see.

"*Information.* We will have a special phone at that desk, listed under A. G. C.—Phone number 241. Call

that number if you want to locate some one or if you want any other information.

"*Plans.* We will have, at that information desk, the plans for every job in the letting and tables on which you can study them. The plans can be seen there from 5:00 p. m. until 9:00 a. m.

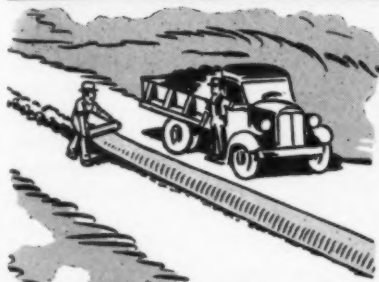
"We are pleased to invite you to make use of these services, without cost to you, and please do not forget to register."



ACCIDENT ON BULLDOZER REPAIR

A bulldozer, with its track being removed for repairs, was about to be pulled off the track by another tractor. The operator of the first machine was requested to crank his engine so that it could be used to provide additional power. While standing on the arm of the bulldozer to do so, the second machine gave a sudden pull, causing the operator to lose his balance and step on the moving track. His foot was caught between the track and running board, causing a broken foot. The foreman of the injured was suspended one day without pay for failing to properly supervise the operation.—*From a Bulletin of National Safety Council.*

When Rain Comes - DOES YOUR PROFIT GO!



Sisalkraft Road Blankets are available in convenient sizes — specially pre-treated for high wet-strength—to resist shrinkage, scuffing, and fungus rot due to soil bacteria.

YOUR profit on the job can be eaten up by labor costs drying out windrows, lost time, wasted materials, idle equipment and demurrage — unless you protect your aggregate against profit-destroying rain.

Cover your windrows — both ahead and behind your mixer—with tough, waterproof Sisalkraft Road Blankets. Low in original cost, Sisalkraft is so tough it can be used over and over again — pays for itself repeatedly in time and labor saved — and speeding up of the job.

SISALKRAFT ROAD BLANKETS

Stop THE WEATHER
—DON'T LET THE WEATHER
Stop YOU!

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BROCHURE — WITH PICTURES
AND FULL DETAILS.

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205 W. WACKER DRIVE • CHICAGO, ILLINOIS
NEW YORK CITY • SAN FRANCISCO

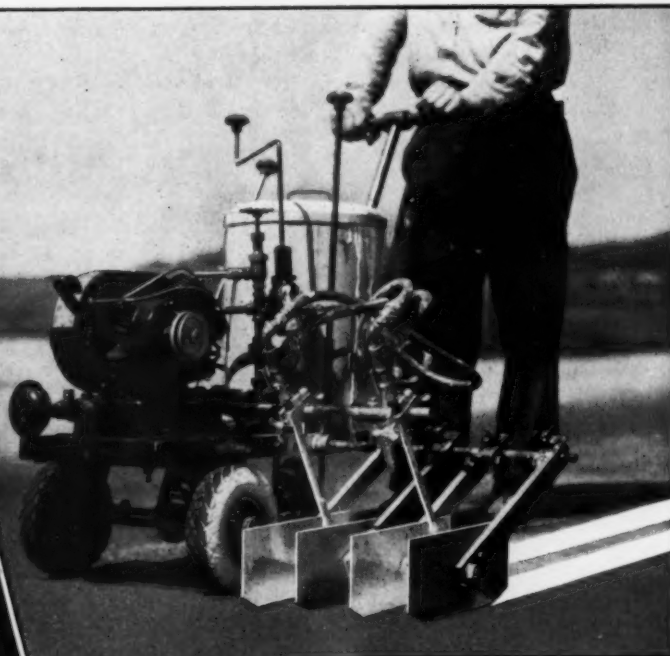
Announcing the New TRAF-O-LINE MARKER

Here's the newest of Line Markers! The Littleford Traf-O-Line Marker. It's new in principle, costs less to operate, will put down single or double razor edge lines on any surface faster, easier, and more efficient than any marker you have ever seen.

The Traf-O-Line Marker will handle any kind of paint, lacquer, cutback asphalt or white wash. No more clogging up of the lines, no more paint settling, no more pressure lines to leak. One control stops and starts spray instantly.

This Traf-O-Line Marker is the most modern marker ever developed. For further details, write Littleford Bros., Cin., O.

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LOW IN
PRICE



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EDITORIAL

ON WRITING

ENGINEERS get so close to the details of their work that they often do not appreciate the unusual characteristics of their projects. Without exception, those with whom the writer has talked when he has called upon them have so close and accurate a knowledge of their jobs, their programs, or their designs, that they see their work as simplicity itself. Yet when all the details are dovetailed together a composite picture results that is interesting as a whole to the uninformed. Invariably the reply to the visitor's question as to what is new or interesting, will be, "We've nothing out of the ordinary; just the regular construction and maintenance." Yet, after a few minutes discussion there generally appears a phase of their road or street work that is different and therefore, interesting.

It is the writer's belief that this feeling of routine in their work or program administration develops because engineers fail to prepare reports or articles on their assignments. Were they to adopt a plan of placing their thoughts in writing or of describing their designs or construction procedures in writing they would undoubtedly profit personally in the logical development of their individual tasks as well as visualize their part in the scheme of the whole. They would then see that, perhaps after all, there is a phase of the unusual about their tasks.

One engineer said to the writer one day, "I can't write about it but give me the job and I'll get it done." One cannot help but think that, if this man were able to write about his work, explain it, he would accomplish his task with much greater dispatch and efficiency. It has been the writer's experience that the process of thinking involved in placing a construction or design procedure in writing has clarified tremendously, the application of natural laws or engineering science to his work when he was a practicing engineer or superintendent. For their own economic benefits, engineers (and contractors) should do more writing about the work on which they are engaged. The chief appreciates a well written report, illustrated and detailed. He may not request it, but it is a safe bet that he will remember it.

ECONOMICAL COMPACTION NEEDED

WHEN we find a weak link in a chain we are using, generally we replace it with a strong one. That is exactly what we should do in the link of construction procedure where grading for embankment construction or stabilized soil surface is concerned, in building a road or street. For example, let us consider the compaction link of stabilized soil road construction.

Present construction procedure employs the sheep-foot roller for compaction or densification. This is a notoriously uneconomical unit for obtaining the result desired. One need only watch construction procedure to see how many times a tractor with sheepfoot rollers in tandem has to pass over a stabilized road mixture to consolidate it when it will be readily recognized that this step is very uneconomical. It is granted that the sheep-foot roller is the best tool we have at the moment, but that should be all the more reason why engineers should be asking for some better unit. It is conceivable that a unit could be developed which would consolidate the stabilized mixture in one or two passes.

The idea of fill compaction, and soil consolidation in highway construction is here to stay. It is just as necessary in earth dam construction or any other kind of work where soil is made up as a fill, layer by layer. This being the case, we should demand that manufacturers give us a machine or tool that will fulfill the requirements of good engineering with economy. At present, the field is wide open for exploration and development.

The old end-dump method of embankment construction should have passed out when the team and dump wagon bowed to the tractor and truck. It didn't. The method clung until a few years ago when engineers recognized that the best embankment construction was that put up in layers. Now, scarcely ever does an engineer permit the old end-dump method. Fills built in layers must be compacted. Compaction to a specified density in weight per cubic foot at optimum water content is preferred present practice. To accomplish the desired result contractors have resorted to the only tool available. That tool should now follow the 2-up or 3-up bottom dump wagon into the category of "past practice."

MUDDLED JOINT OPINION

UPON reviewing specifications of the 48 states in the matter of joint filler and joint design of rigid pavements, one will find such drastic variations in design, size, spacing, specifications on extrusion, compression and recovery, as to leave no doubt that engineering logic employed is questionable. It will be found that thicknesses of joint filler vary from one-half inch to one inch and that joint spacings vary from 44 feet to 200 feet. Dowel spacings and load transfer requirements indicate wide variations. The review of present practice reveals that some of the states are using the old premoulded asphalt joint, while others are employing the resilient types.

Certainly, expansion joints have a definite function. Once they are created, the next problem, of course, is to transfer the rolling load from one slab to the next. Experimental work on load transfer should result in a consistent theory of the function and character of fabrication of transfer devices. Having obtained a sound theory on load transfer, the mechanics of its accomplishment becomes related to fabrication of the joint. It seems to the writer that a fairly consistent standard in joint design would be a logical development. At least, it is a condition toward which we should bend our energies.

At the present time, politics and sectional self-interest apparently are the dominating influences in joint design and specification. Is this engineering? Specifications for resilient expansion joints include statements on the ability of the material to comply with requirements in compression, extrusion, and recovery. The wide variation in these requirements leads one to question the engineering logic of the opinions reflected by the specifications. For instance, some specifications require a material with compression under 100 lb. per sq. in., whereas others are set at 1500 lb. per sq. in. This same wide spread of opinion will be found in the recovery test requirements, which range from 50 to 95 per cent.

This subject needs clarification and a greater degree of standardization. It should be studied not only by the American Association of State Highway Officials, but also the American Road Builders' Association and the Highway Research Board. The present condition is nonsensical.



The Insley Shoulder Finisher is the most effective and economical equipment available for grading and finishing to accurate lines, the shoulder and back-slope on road-paving jobs. It has repeatedly proved that it can grade and finish both sides of a mile roadway in a day . . . in one operation.

Two men operate the Insley Shoulder Finisher which is pulled by either a light tractor or 5-ton truck. Expensive and inaccurate hand labor is eliminated. Available in two different types with blades capable of finishing shoulders from 5 ft. to 11 ft. wide. Insley Manufacturing Corporation, Indianapolis, Indiana.



INSLEY

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**3/8 YD
1/2 YD**

Cost-per-Yard goes DOWN!

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NEW EQUIPMENT AND MATERIALS

New Koehring Trail-Dump

The Model T-8 Trail-Dump is described in a catalog just issued by Koehring Company, Milwaukee. The wagon carries 8 yards crowned or 6½ yards struck. The tractor is available in Standard Model (gasoline), Diesel Model, and Super Pow-



The Trail-Dump

er Model (gasoline). Each model has four forward and one reverse speed, the forward speeds being listed as from 3.5 to 16.5 MPH for the Standard, 3.8 to 18.0 for the Diesel, and 4.25 to 20.0 for the Super Power. Construction and mechanical details are described and illustrated. Specifications are included.

A New White Paint for Highway Structures

A high grade whitewash paint made with calcium chloride solution as the vehicle for lime has been recently developed in the Road Research Laboratory of The Dow Chemical Company, Midland, Mich.

According to Herman H. Miller, Dow research engineer, this new paint is very durable, will not dust, is easy to apply and may be colored with oxide pigments. By adding fine silica or quartz sand (28-mesh and fine) to the mix, an excellent finish for interior concrete, concrete and cinder blocks, and brick walls may be made.

A typical formula for the lime wash calls for 8 gallons of calcium chloride solution to 50 pounds of lime. In making the sand-lime wash, 8.5 gallons of calcium chloride solution are used to 50 pounds of lime and 70 pounds of sand (white preferred).

The calcium chloride vehicle is prepared on the basis of one pound of calcium chloride in approximately ¾ gallon of water. After the chemical is thoroughly dissolved, additional water should be added, during agitation of the mix, to bring the volume to one gallon. This is then combined with the dry, slaked lime or lime and sand in the proportions mentioned above. This forms a thick jell which must be allowed to stand in a covered container for at least 24 hours to complete the oxychloride reaction. The gelatinized mixture is brought to the desired consistency by adding water. Constant stirring should accompany this process to insure that the paint is kept free from lumps.

This whitewash can be applied with either a brush or spray gun. One bag of lime will make approximately 10 gallons of lime wash and 15 gallons of sand-lime

wash when properly prepared by the above formula.

New ¾-Yard Excavator

Universal Power Shovel Corporation, Milwaukee, Wis., announces a new ¾-yard shovel to complete its line of small sized excavators. The new machine is known as the 1020 model. Although of unusually lightweight construction, it is said to have an abundance of speed and power for heavy duty performance. Equipped with 19 ft. boom and 14 ft. stick to provide ample reach and dip for practically any type of job. Crawlers are 11 ft. 5 in. by 20 in., running on drop forged, heat-treated rollers. All gears and bearings are fully enclosed in a dust-proof, oil-tight one-piece cast case. The company claims this feature eliminates the need for greasing or adjustments, affords protection against metal-cutting abrasives, reduces friction and prevents misalignments.

Other unit engineered features include drop-forged, heat-treated alloy steel gears



Universal Power Shovel's Latest

...shafts full-floating mounted in ball bearings...ten spline fittings throughout main machine case...massive double disc clutches...direct drive from engine to countershaft...power unit mounted integral with operating mechanism...turn-table mounted on four drop-forged, heat-treated conical rollers...drums mounted on short, individual, splined shafts. No bushings to lubricate or replace...single screw crawler adjustment, packed in grease.

The Unit 1020 is convertible to all attachments. Literature describing this machine in detail is now available.

Keuffel & Esser Co. Produces New Type Tracing Paper

An entirely new type of tracing paper combining the transparency of oil treated

sheets with the permanence of natural 100 per cent rag papers is a recent development of the Keuffel & Esser Company, of Hoboken, N. J. The new paper is named Albanene. It is made of 100 per cent long fiber clean white rags and is treated with a new crystal clear synthetic solid called *Albanite*, developed in the K&E laboratories. Because this new transparentizing agent is free from oil and wax and both chemically and physically inert, it is claimed that Albanene will not oxidize, turn yellow, become brittle, or lose transparency with age.

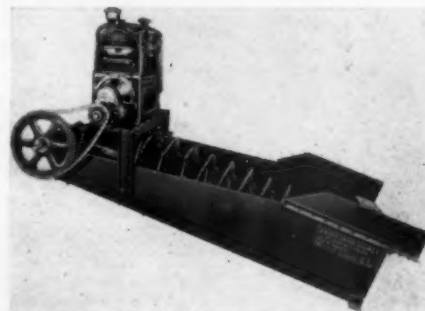
According to the manufacturer, the new chemical has remarkable penetrating power so that an extremely long fiber base paper can be used, giving Albanene an unusually high strength factor by all standard paper tests. The ability of Albanite to penetrate "wild" fibers gives Albanene unprecedented transparency and superior blue printing quality, the manufacturer states.

It is further claimed that the use of this new type transparentizing agent permits a fine toothed, smooth drawing surface that takes strong pencil lines with a minimum wear on the point. On Albanene all lines are held by the fine hard tooth and do not become imbedded in the paper structure, making Albanene extremely easy to erase or correct.

Albanene is offered in three weights—light, medium and heavy. An illustrated brochure and a generous working sample of this new paper can be secured by writing to the manufacturer.

Diesel Powered Sand Washer

An interesting application of Diesel power is shown in the accompanying illustration. The Hercules Diesel 4-cylinder power unit Model DOOB, 3¼-in bore by 4-in. stroke, furnishes power for operating a double screw sand gravel washer, manufactured by Eagle Iron Works, Des Moines, Ia. As will be noted this washer is a completely self-contained unit with the engine readily accessible for servicing, yet out of the way so far as the operation of the washer is concerned. The washer consists of two spiral screws each 12 ft. long. These screws draw the aggregates to the center of the tub and convey them upward



Diesel Powered Sand Washer

FREE TO YOU

"ENGINEERING IN TIMBER" . . .

A pictorial 23-page booklet, illustrating the TECO Connector system of timber construction . . . over 14,000 structures built. Send for Free copy today.

The engineers' "timber handbooks," Wood Structural Design Data, \$1.00 per copy, and supplements, 25c, published by National Lumber Manufacturers' Association, U. S. postage paid.



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Stronger Joints
Less Material



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Made Easy

Union Road Joint
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ONE-PIECE.

Patented

Dowels Accurately
Positioned and
Locked Parallel.

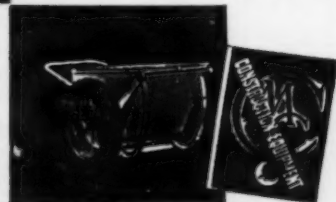


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Move More Snow..."*

AT A HIGHER RATE
OF SPEED WITH OUR

AMERICAN AD1 Snow Plow

mounted on a 1½-ton four-wheel drive truck than with our old plow of other make mounted on a 3-ton four-wheel drive truck."

That sums up the superiority of AMERICAN Snow Plows very neatly — and coming from an organization that paid out good money for the plow it perhaps may carry more conviction than anything we might say. Write today for your copy of our new Snow Plow Catalog SNP-5. It will show you sure ways to lighten your winter worries.

The Genuine CROSBY CLIP



AMERICAN HOIST & DERRICK CO.

NEW YORK ST. PAUL CHICAGO

AMERICAN TERRY DERRICK COMPANY
SOUTH KEARNY, N. J.

to the discharge end. Wash water inlets are arranged along the tub between the two screws. In operation the wash water swirls upward through the aggregates carrying the foreign matter to the surface and down to lower waste water discharge end of the tub. Timken roller bearings carry the upper ends of the spiral screw shafts and cutless rubber bearings are used at the lower ends of the shafts which are subject to abrading action of the sand and water.

▼ Caterpillars' New Light Weight Motor Grader

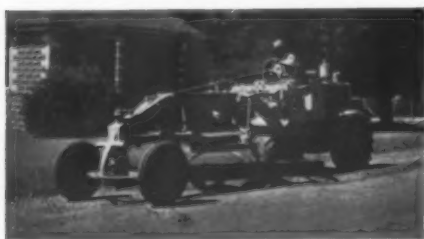
A 32-horsepower motor grader, the No. 212, weighing approximately 10,500 pounds and available with either diesel or gas-line engine, has been announced by Caterpillar Tractor Co., Peoria, Illinois.

The new machine, completing the "Caterpillar" line of all-purpose motor graders, is especially well suited for cities, townships, special road districts, counties and other political subdivisions. Its overall width is only 6 ft. 8 in., and a 10 ft. blade makes it ideal for use on narrow roads where traffic would find it difficult to pass a wider machine.

Every blade position possible with the larger No. 12 and No. 112 models can be equally well obtained on the No. 212. It is thus possible to cut ditches and slope banks, widen and regrade roads from bank to bank, scarify and reshape pitted surfaces on gravel roads or city streets, maintain road surfaces, mix and spread light oil mat.

A full revolving blade permits the machine to work in reverse, a valuable feature on short jobs, or where turning is difficult or impossible.

The No. 212 motor grader will be offered with single drive only, equipped with 12.75-20 single low pressure tires. The ground contact afforded by these tires,



The Number Two Twelve

together with engine weight directly over the driving wheels, provides well balanced traction to utilize the available horsepower.

▼ Insley's New Readymix Receiving Bucket

Insley Manufacturing Corporation, Indianapolis, report contractors are showing considerable interest in the new Readymix Receiving Bucket. It is designed to be used on any concrete placement job having hoisting equipment. Insley engineers believe the readymix receiving bucket offers the fastest, cheapest possible method



Top: The entire truck mix being loaded into Readymix Receiving Bucket while lying flat on the ground.

Bottom: Spreading the load directly from the Readymix Receiving Bucket to avoid hand spreading. One operator is all that is necessary to pour thick floors, columns, or exterior walls.

of handling concrete between readymix trucks and forms.

This unit is claimed to be the first and only bucket that can lie flat on the ground and low enough so the entire batch of truck mixer can be discharged into it. Upon being picked up with the bail, the bucket rights itself, so as to discharge through a radial gate at the bottom of the bucket. The narrow discharge gate makes it particularly effective in pouring columns or exterior walls. Once hoisted, the readymix receiving bucket is moved anywhere and concrete can be placed to the exact spot. It is equipped with the same type, grout-tight, wear-proof gates that have proved efficient and durable on Insley equipment for many years.

In pouring thick slabs the readymix receiving bucket is normally operated by one man, but most hand spreading can be eliminated on thin slabs by using two or more men to swing the bucket while pouring. This bucket not only eliminates the use of wheelbarrows, carts and runways, but has the additional advantage of releasing the readymix truck immediately after a quick discharge.

▼ A New Trench Hoe Convertible for Seven Types of Service

The Harnischfeger Corporation of Milwaukee announces the new P&H Model 255 Trench Hoe—a $\frac{3}{4}$ -yard machine built for handling a wide range of materials-

handling work. In addition to its use as a trench hoe, this machine can be converted into a shovel, dragline, clamshell, crane, skimmer scoop or pile driver.

Combining rapid line speeds with ample power, the Model 255 is equipped with tractor-type crawlers for fast, easy travel. It has three forward speeds ranging from $\frac{5}{8}$ to $2\frac{1}{2}$ miles per hour. There's a change of pace in digging, too, to meet the needs for snappy power in easy or tough going. This machine is equipped with a swivel-type hoe stick pivot bearing which is designed to absorb shocks by eliminating twists in the boom. Easily convertible for shovel use, the Model 255 is built of all-welded alloy steels throughout for greater strength, more resistance to shock loads and, withal, an appreciable reduction in weight.

In the photograph, the bottom dump bucket is shown, but the Model 255 can also be equipped with a solid dump bucket. This trench hoe will dig to a maximum depth of 18 ft. and the solid dump bucket will cut a trench with side cutters 34 in.-36 in.-38 in. wide, with bottom dump bucket 32 in.-34 in.-36 in. wide. For further information address the Harnischfeger Corporation, 4400 W. National Avenue, Milwaukee, Wis.

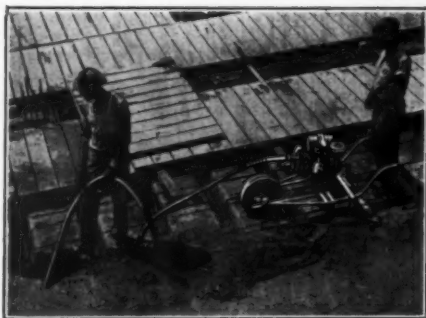


P. & H. Model 225 Trench Hoe

▼ New Reflex Reflector Signal

A new reflex reflector signal for trucks, trailers and buses has been introduced by the AC Spark Plug division of General Motors, Flint, Mich. The brightness of the new reflector, which is known as Series 13, exceeds that of the most brilliantly lighted tail lamp at distances from 300 to 700 feet. It is stated to be so powerful that it is instantly seen a quarter of a mile on the road, and normally its candlepower at 300 ft. is 16 times the requirements set for reflectors in the specifications of the Society of Automotive Engineers. On winding roads and on dips in a rolling highway, the visibility of the new reflector is correspondingly efficient. Optical precision at low cost has been achieved by making the reflector signal of "Lucite," methyl methacrylate, a new member of the plastic family, developed by engineers of the E. I. du Pont de Nemours Co. An interesting characteristic of the new reflector, which has the physical appearance of glass, is that it resists breakage to a remarkable degree

PLACE CONCRETE FASTER, BETTER, CHEAPER WITH *Mall* VIBRATORS



Pneumatic wheel mounted 3-H.P. gasoline engine vibrator. Can also be used for SURFACING, PUMPING, SAWING, GRINDING and DRILLING.

Get better bond with reinforcement—get denser and stronger concrete—eliminate aggregate pockets and expensive patching. A type and size for every job! Send for circulars on the many gas engine, air and electric models, and let us advise you regarding the proper unit for greatest savings on your work.

MALL TOOL COMPANY

7765 South Chicago Avenue Chicago, Illinois

OFFICES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

OK AIR COMPRESSORS

are made in a full range—in both single and two stages:

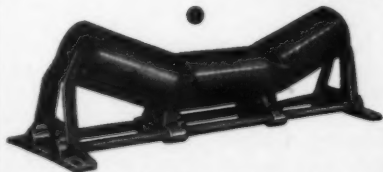
Gasoline, diesel & electric driven. Illustration shows TS 210—the only dual wheel compressor on the market.

Ask for Bulletin C 40 for complete information.



O. K. CLUTCH & MACHINERY CO.
COLUMBIA, PA.

DIAMOND Anti-Friction CONVEYOR ROLLS



Write for further information

Latest type design. Timken bearings—with improved dust seals. Equipped for high pressure lubrication.

DIAMOND IRON WORKS INC.

AND THE MAHR MANUFACTURING CO. DIVISION

MINNEAPOLIS, MINNESOTA, U. S. A.

LET THE HIGHWAYS THEMSELVES MAKE YOUR PIPE DECISION



There is no test more conclusive than performance, and it is here that GOHI Corrugated Pipe demonstrates its amazing endurance, its ability to deliver trouble-free service under the most severe conditions at the lowest per year cost. Economical to buy, to install, to maintain, GOHI Corrugated Pipe is the logical answer to highway and other drainage problems. Complete information and copy of 72-page book on modern culvert practice on request. Address fabricator nearest you.



GOHI Pipe meets Copper-Bearing Pure Iron requirements in all specifications published by nationally recognized specifying authorities.

New England Bolt Co.	Everett, Mass.
Central Culvert Co.	Ottumwa, Iowa
Capital City Culvert Co.	Madison, Wis.
Bancroft & Martin Rolling Mills Co.	S. Portland, Me.
Denver Steel & Iron Works Co.	Denver, Colo.
The Lane Pipe Corporation	Bath, N. Y.
Dixie Culvert Mfg. Co.	Little Rock, Ark.
St. Paul Corrugating Co.	St. Paul, Minn.
The Newport Culvert Co.	Newport, Ky.

GOHI PIPE

CORRUGATED

GOHI CULVERT MANUFACTURERS, INC.
NEWPORT, KY.

and when struck a heavy blow it will crush or bruise only in the spot struck. The reflector performance usually is affected only slightly by such a blow. The new reflector is pressed from transparent "Lucite" into a 3-in. disc-shaped signal containing 275 precision cube configurations. The headlamps of a motor vehicle provide the indirect lighting. Light from the headlamps strikes the reflector installed on the rear of a vehicle ahead, and a large proportion of that light is returned as a beam of brilliant illumination for the oncoming driver. Each of the 275 cube corners in the signal is a complete retro-directive optical system in itself. A light ray entering the front surface is reflected from surface to surface of the three faces of its cube, and after the third reflection is automatically directed back toward the approaching headlight, practically regardless of what the entrance angle may be. As a further result of this development, it is believed that the reflectors will be extensively used for highway lighting. Last year, after installation of an "experimental" reflector-lighted system on one of Michigan's highways, night accidents on that highway dropped 60 per cent in nine months compared with such accidents for the same period during the previous year.

▼ Mower Has Two Sickle Bars

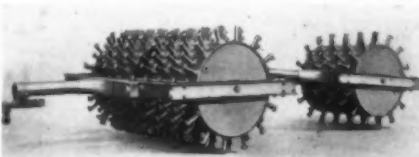
The illustration shows a tractor mower equipped with two 5-ft. sickle bars. The machine, a product of the Toro Manufacturing Corporation, 3042 Snelling Ave., Minneapolis, Minn., is one of several built to order for the Connecticut State Highway Department for use on certain portions of the new Merritt Parkway. The tractor is the Toro Bullet model equipped with a 6-cylinder engine and a 4-speed transmission with a traveling range of from 3 to 45 m.p.h. The sickle bars are orthodox in construction, but are novel in application due to the fact they are entirely controlled by power. The bar on the right-hand side is driven by a takeoff from the tractor transmission. The bar on the left-hand side is driven by an independent air-cooled single-cylinder motor. Either sickle is raised in 2½ seconds. The reason for the left and right handle bars is so the machine can operate on congested center strip parkways with the traffic. It also is of value in airport cutting or any similar large flat acreage.



Tractor Mower Equipped with Two 5-Ft. Sickle Bars

New Galion Sheepfoot Roller

Galion Iron Works & Mfg. Co., Galion, Ohio, announces the roller pictured herewith. The rolls are 40 in. in diameter and 48 in. wide with 7 in. feet. Weight



Galion Sheepfoot Rollers—Double and Single

of roll depends upon the number of feet desired. It is available with 64, 72, 88, 96, 112 or 120 feet. Each foot weighs 8 lb. The weight of each roll can be increased 1,850 lb. with water ballast.

Weights (with 112 feet) empty, single unit, 3,140 lb.; double unit, 6,500 lb. Weight (with 112 feet) ballasted, single unit, 4,900 lb.; double unit, 10,200 lb.

The special Galion hitch makes it easy to couple roller to tractor, as well as to couple rolls together to work in tandem of singles, doubles, or any other arrangement desired, depending upon power available. The feet are cleaned by passing through a set of teeth on frame cross-member.

▼ New Bank Sloper

Something new in a sloping machine. This device was used on a bank 350 ft. long and 35 ft. high. The bank consisted of a layer of sand, a hard layer of clay and layer of loam. Each layer approximately 11 ft. thick. The material to be



Cornett Sloper

sloped ranged in thickness from 4 in. to 2 ft. thick. It required 8 hours to slope 12,250 sq. ft.

It is stated that the machine can slope from the vertical to an approximate horizontal, and that it can be attached to any shovel in an hour's time. Instead of removing the bucket as shown in the picture, it is now possible to attach it to the end

of a shovel tooth, which saves removing the bucket.

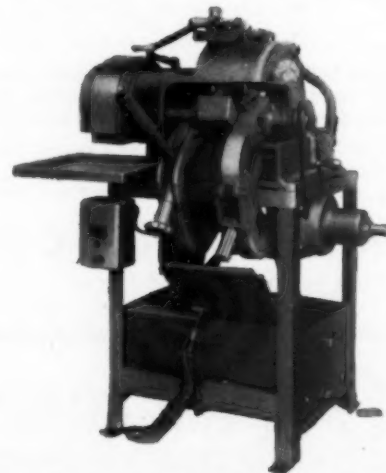
With the shovel boom elevated to approximately vertical and a 20-ft. sloper boom, it would reach to a height of 38 ft. The sloper boom can be made in longer lengths.

The machine is known as the Cornett Bank Sloper and is made by Concrete Cutting Corporation of America, 607 Degraw St., Brooklyn, N. Y.

▼ New Non-Automatic Jackbit Grinder

A new non-automatic jackbit grinder has just been announced by Ingersoll-Rand. This machine is adaptable for use with all types of standard detachable rock-drill bits as used by mines, quarries, contractors, etc.

Known as Size J-3, it has a capacity of 35 hard bits or 50 annealed bits per hour, compared with a capacity of 60 hard bits or 100 annealed bits for the "Size J-5" semi-automatic jackbit grinder introduced



New Ingersoll-Rand Size J-3

in the Spring. Both machines are available for electric, air, gasoline-engine, or belt drive.

Complete information on both of these machines, as well as two new blacksmith shop machines, the size 500 drill steel cutter and shank grinder and the size 4P pedestal grinder, is contained in a new illustrated twelve-page folder, form 2554, copies of which are available from Ingersoll-Rand Company, 11 Broadway, New York City, or any of their branch offices.

▼ New Insley Shoulder Finisher

Insley Manufacturing Co., of Indianapolis, has brought out a machine for the finishing of earth shoulders up to 11 ft. wide, and with back slopes up to 8 ft., in a single operation. The finisher is operated by one man and may be pulled with a light tractor or heavy truck. It is adjustable to meet the shoulder specifications of various state highway departments. Main blades are available in various lengths from 6 ft. to 12 ft. 6 in. and are adjustable up and down on both the inner and outer end.

An offset hitch enables the hauling truck or tractor to keep off the pavement. A bulletin giving complete specifications has been prepared and will gladly be sent on request.

WITH THE MANUFACTURERS

Lawrence E. Joseph Heads Blaw-Knox Division

Blaw-Knox Company announces the appointment of Lawrence E. Joseph as executive officer in charge of its Blaw-Knox Division. Mr. Joseph succeeds R. F. McCloskey, Sr., a company vice president, who was placed in charge of the development of new products for the entire corporation.



Mr. Joseph, until the first of this month, was manager of the National Automatic Tool Company, Richmond, Ind. Prior to that connection he was a vice president of the Liggett Spring & Axle Company, and previously was engaged as a consulting engineer.

Universal Atlas Holds Open House at Muskegon

Several hundred business and civic leaders of southern Michigan attended the informal open house program on August 15 of the new Muskegon, Mich., storage and packing plant of the Universal Atlas Cement Company.

The plant consists of five storage tanks built of concrete with cone bottoms. The packing room and sack building are steel frame covered with corrugated cement-asbestos roofing and siding.

Cement is shipped in bulk from the Chicago (Buffington, Ind.) plant of the company in the motorship "Steel Chemist" and unloaded by a special Fuller-Kinyon high capacity portable unloader. From the storage tanks cement is loaded in bulk or in bags to cars or trucks for delivery to market.

The plant is located at The Mart, Muskegon, one of the largest and most active commercial docks and progressive distributing centers on Lake Michigan.

Harrod to Represent Chain Belt at Syracuse, N. Y.

On August 10, Chain Belt Company of Milwaukee announced the appointment of Harrod Equipment Company, P. O. Box 51, Eastwood Station, Syracuse, N. Y., Location, Thompson Road and James Street, as exclusive distributor for the complete line of Rex construction equipment in the Syracuse territory.

Mr. L. G. Harrod has been identified with the construction machinery industry in Syracuse for many years; with him are Mr. D. K. Howe and Mr. J. B. Petz.

The Rex line of construction equipment that will be handled by the Harrod Equipment Co. consists of mixers, pavers, Moto-Mixers, Speed Prime centrifugal pumps, plaster and mortar mixers, cold patch mixers, diaphragm pumps, road pumps and the Rex Pumpcrete.

The company maintains a warehouse at the above address and is ready to give prompt service on equipment requirements and also on service requirements. They can be reached on the telephone at any time by calling Syracuse 2-7877. They also represent several other high grade manufacturers of construction equipment.



W. J. Adams, Gil Koehler, J. E. White

added to the engineering staff; Mr. Kerrick and Mr. Koehler have been made field representatives; and J. E. (Joe) White, sales engineer, road machinery division.

Continental Scraper Men Join Gar Wood Industries

Coincidental with the recent acquisition of the tractor equipment division of the Continental Roll and Foundry Company of East Chicago, Indiana, by Gar Wood Industries, Inc., Jack B. Haile, manager of the Gar Wood road machinery division, has announced the appointments of W. J. (Bill) Adams, J. E. (Joe) White, Duke Kerrick, and Gil Koehler, all formerly connected with the tractor equipment division of the Continental Roll and Steel Foundry Company.

W. J. (Bill) Adams, who worked the first Continental scraper in the field and the original designer and patentee of the two-wheel Continental scraper, has been

Goodrich Service Men

Five members of the field staff of the mechanical division of The B. F. Goodrich Company have recently completed 20 years of service with their organization. They are:

Samuel R. Potter, district manager, St. Louis; F. Elliott Wood, salesman, and Mrs. Elsa C. Boone, clerk in the New York district; H. L. Green, salesman, Denver district; and Edward F. Heckman, salesman, Philadelphia district.

They now become eligible to join the Goodrich Twenty Year Service Club, which has more than 2,400 members, each of whom has served the company one-fifth of a century or longer.

E. N. David, in the Akron sales office, has recently completed 30 years of service.



● Heltzel heavy duty battered curb forms are the simplest to set and fastest to strip because all stakes are driven straight down. Catalog S-20-F.

HELTZEL

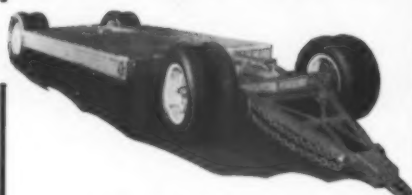
STEEL FORM & IRON CO.
WARREN, OHIO, U.S.A.

Heltzel

BUILDS IT BETTER

BINS, Portable and Stationary
CEMENT BINS, Portable and Stationary
CENTRAL MIXING PLANTS
BATCHERS (for batch trucks or truck mixers with automatic dial or beam scale)
BITUMINOUS PAVING FORMS
ROAD FORMS (with lip curb and integral curb attachments)
CURB FORMS
CURB AND GUTTER FORMS
SIDEWALK FORMS
SEWER AND TUNNEL FORMS
CONCRETE BUCKETS
SUBGRADE TESTERS
SUBGRADE PLANERS
TOOL BOXES
FINISHING TOOLS FOR CONCRETE ROADS

TRAILERS



**FOR EVERY
HEAVY DUTY
REQUIREMENT**

**Single, Dual, Tandem
and Multiple Axles**

Capacities from 5 Tons Up

—Write or Wire—

C. R. JAHN CO.

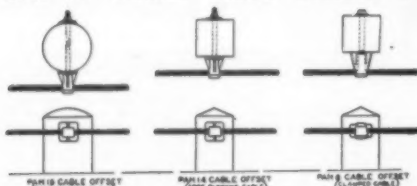
General Offices and Plant

1345 W. 37th Pl. CHICAGO, ILL.

*"Come to Trailer
Headquarters"*

M.I.F. Cable Offsets

The Cable Offsets (patented) illustrated are preferred alternate standards in various States because of



rugged construction, attractive appearance, ease of installation and reasonable price. Two types at left for round and square posts, otherwise similar, are used with free-running cable. Compensating Spring End Anchorage construction, etc. Type at right clamps cable rigidly at each post.

Other types available for converting hook bolt construction to offset construction; also saddle type End and Intermediate Anchorage Post Offsets.

Sample recommended Cable Offset will be sent free to responsible Highway Official or Contractor on receipt of data as to post dimensions, cable rating, etc.

Other M.I.F. Specialties include: Compensating Spring Anchorages, Union Type Cable Splices, Wedge Type Cable End Sets, Offset Pipe Railings, etc.



MALLEABLE IRON FITTINGS CO.

Pole Hardware Dept.
Branford, Conn.

Le Tourneau Adopts Broderick & Bascom Rope as Standard

An announcement from St. Louis states that R. G. Le Tourneau, Inc., has adopted Broderick & Bascom "Flex-Set" Preformed Yellow Strand Wire Rope as standard equipment on all their "cable controlled" machines.

New Plant for Hough Loaders and Sweepers

The Frank G. Hough Co., manufacturers of hydraulic loaders and other tractor front-end equipment and motor pick-up sweepers, road blowers and combination sweeper-blowers, have centered their activities at their new plant located at Libertyville, Ill., a suburb of Chicago. Executive offices and the engineering, purchasing and sales departments will be located at the new plant.

Manufacturing will continue at Plant No. 2 at New Holstein, Wis., which will concentrate on standard models of Hough equipment, special models and newer equipment being made by Plant No. 1.

The addition of these manufacturing facilities will double the production capacity and provide ample space and facilities for experimental work, equipment operation studies and new equipment development.



The New Hough Plant at Libertyville, Ill.

Cleveland Worm & Gear Company and the Farval Corporation Combine Chicago Offices

The Cleveland Worm & Gear Company, manufacturers of worm gear speed reducers, and The Farval Corporation, manufacturers of centralized lubricating systems, have consolidated their Chicago offices at 327 South La Salle Street, Suite 1525-26.

E. J. Ehret and John D. Kinsey, who have represented both concerns in Chicago for several years, are in charge. The telephone number is Wabash 4146.

George B. Comfort Made Manager of Sales Promotion for Schramm

Schramm, Inc., West Chester, Pa., manufacturers of portable and stationary air compressors, announce the appointment of Mr. George B. Comfort as manager of sales promotion.

Mr. Comfort has been associated with Schramm since 1924, having served in the capacity of factory manager and more recently as manager of engineering sales.

Burke Named Federal Truck Vice-President

Joseph D. Burke, one of the best known figures in the truck industry, who resigned as Director of Truck Sales, Dodge Division of Chrysler Corporation, last March, has been named Vice-President in Charge of Sales of the Federal Motor Truck Company, of Detroit, according to an announcement by R. W. Ruddon, President.

Mr. Burke entered the automotive industry by joining Studebaker in 1909 and has been engaged in truck sales since 1915, when he joined the Packard Truck Division. He remained with Packard until truck manufacture was discontinued in 1922—with two years out for active service in France with the Motor Transport Corps of the army. In 1923 Burke joined Graham Brothers in charge of their national fleet sales, later becoming Dodge Brothers' district representative in Los Angeles. In 1928 he was Assistant Sales Manager of the Fargo Motors Corporation, a division of Chrysler, returning to Dodge as a regional truck manager in New York in 1929. In 1932 Burke was made Director of Truck Sales for Dodge, which post he retained for seven years. Under him Dodge truck sales grew from 10,000 to over 100,000 units per year. Mr. Burke will have the active assistance of K. M. Schaefer, for the past two years General Sales Manager of Federal and who has been responsible for a substantial increase in the number of Federal dealers.

Bucyrus-Erie Moves Southern District Office From Birmingham to Atlanta

The Southern District office of Bucyrus-Erie Company was moved to Atlanta, Ga., on August 21. This office, formerly located in Birmingham, Ala., serves a district including the states of North Carolina, South Carolina, Tennessee, Georgia, Florida, Alabama, Mississippi, Arkansas and Louisiana. The new office is located at 1508 William-Oliver Building, Atlanta, phone Jackson 1545. Since the new Atlanta office provides a more central point from which to serve the excavating industry of the South and Southeast, his removal is in line with the Bucyrus-Erie policy of continually improving its facilities for service to its customers and prospects.

Joseph E. McGrogan Goes With Equipment Rental Co., of Philadelphia

Mr. Joseph E. McGrogan has accepted the position of manager of the Schramm Department of Equipment Rental Company, 3717 Filbert Street, Philadelphia, Pa.

Mr. McGrogan has been associated with Schramm since 1918, most of the time as office manager of the Philadelphia branch, 709 Arch Street, under District Manager T. H. Jayes.

Equipment Rental Company are prepared to do a complete sales, rental and service business in Schramm compressors, Cleveland tools and General Electric welders.

Tournapull Plant Dedication at Toccoa, Georgia

On July 11th, a few miles from Toccoa, Ga., Mr. R. G. LeTourneau dedicated another of his great road machinery factories—The LeTourneau Company of Georgia.

On the 2,000-acre tract, located between U. S. Highway 13 and the main line of the Southern Railroad, a 400-ft. square, all-steel, electrically welded factory building has been erected—the largest, most modern factory of its kind in the South.

The latest developments in machinery



Mr. LeTourneau Speaking at the Dedication

and conveniences are incorporated in the \$2,000,000 structure. Every part of the building is served by jib cranes, which also serve as center and side supports. Shipping facilities are arranged so that all machinery can be loaded and unloaded without lifting.

This new plant is to be used in the manufacture of Tournapull, the most recent addition to the LeTourneau line of earth-moving equipment. The Tournapull, combined with Carryall scrapers, Rooters and 'Dozers, are establishing dirt-moving history on the Hansam Dam Project in the West. Thirty-yard loads are being moved at truck speeds.

Upward of 5,000 people from Toccoa, the surrounding counties and many distant points witnessed the simple but impressive dedication ceremony. Congratulatory addresses were given by prominent state and national leaders: U. S. Senator Richard B. Russell, Jr., the Honorable E. D. Rivers, Governor of Georgia; Mr. Oliver, 1st vice-president of Southern Railroad System; Mr. Wirt, asst. vice-president of Southern Railroad System, and the Rev. R. R. Brown. Welcome and high praise for Mr. R. G. LeTourneau and the good fortune of Georgia were expressed by all.

In the course of a year the former mere north Georgia woodlands will be changed into a modern steel constructed city. In the next few weeks, Mr. LeTourneau will begin construction of steel residences to house his employees. A modern airport a half-mile from the plant will bring it within 3½ hours' travel from LeTourneau headquarters at Peoria, Ill.

NEW LITERATURE

Tractors Designed for High-Octane Fuels.—Allis Chalmers Mfg. Co., of Milwaukee, has just issued a 24-page, 2-color catalog describing its Model "S" tractor, designed expressly to take advantage of the extra power in the high octane (67-72) gasolines now available. The catalog explains that this tractor is giving increased power with remarkably low fuel consumption because its higher compression engine has been engineered to squeeze the last ounce of power from a stepped up fuel. Owners' letters quoted indicate that this increased compression, combined with automatic spark advance and economizer carburetor, has cut gas consumption to a minimum. Attention is called to the new "SuperSeal" rollers, the only truck wheels that run on roller bearings, and need be lubricated only once every 200 hours. Complete specifications for the tractor are given.

New Bucyrus-Erie 2-Yd. Convertible Shovel.—Complete description of the new Bucyrus-Erie convertible 44-B, 2-yd. shovel is attractively presented in a 32-page bulletin recently published by the manufacturer. Features of the machine are fully explained, and photographic illustrations are used profusely to portray the 44-B's structural and mechanical details. Copies of the bulletin may be obtained free of charge from Bucyrus-Erie Co., South Milwaukee, Wis. Ask for Bulletin No. 44-B1.

New Link-Belt P.I.V. Gear Sizes Announced.—Two new sizes of P.I.V. Gear variable speed transmission units are announced by Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia, and have been included in a new 40-page Book No. 1574, seventh edition. They are No. 0 size, ½-h.p., for speed ratios of 2 to 1 or 3 to 1, and size No. ½, 1½-h.p., for ratios of 2 to 1, 3 to 1, 4 to 1.

These smaller sizes, like the larger units, ranging up to 15-h.p. and up to 6 to 1 speed ratio, can be furnished for horizontal or vertical mounting, motorized or without integral motor, and with or without extra speed reduction gear sets.

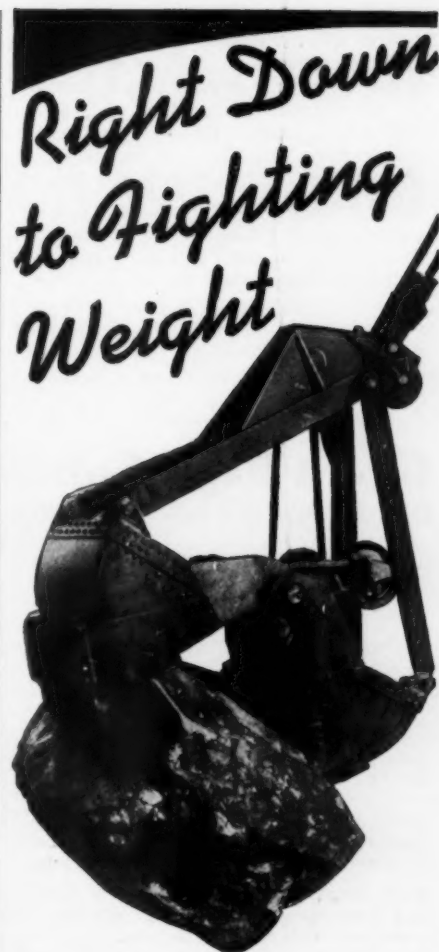
Other new items included in the book are vernier control for extra-fine speed variations, and a convenient table that makes it easy to select the proper size unit for the service. A copy of the new book will be forwarded to any reader upon request.

Caterpillar Booklet.—Specifications and mechanical features of the "Caterpillar" diesel D6 tractor are discussed in a 32-page booklet, just issued.

Giving a complete understanding of the diesel engine that powers the machine, cut-away photographs and explanatory captions are used throughout. Transmission and track construction are similarly handled in separate sections of the book.

Many action photographs, showing the jobs the tractor will do, coupled with owner statements regarding costs and earnings, give a clear idea of the capacities of the machine.

Copies of the booklet may be obtained, free of charge, by writing Caterpillar Tractor Co., Peoria, Illinois.



You want more than dead weight in a bucket to lick a tough digging job. You want speed—agility! Williams design, welded construction and special alloys insure stamina and ruggedness, without excessive weight. Williams Buckets carry plenty of weight, but they carry it in the right places and in the right proportions. You move more materials in less time with Williams Buckets—and that's profitable.

...and if that's what you want in a bucket, you'll find your particular type in the Williams Catalog. It's free!

THE WELLMAN ENGINEERING CO.
7003 CENTRAL AVE. • CLEVELAND, OHIO



Send for Catalog

Distributors located in all parts of the country represent the Williams Line of Power-Arm, Multiple Rope, Power-Wheel, Single Line, Hook-On and Dragline Buckets.

WILLIAMS Buckets

built by WELLMAN

BUILT TO LAST...and MOVE DIRT FAST!

Buckeye Convertible Excavator—An impressive 24-page presentation of the features and operating advantages of the Buckeye Clipper convertible excavator has just been issued by The Buckeye Traction Ditcher Co., Findlay, Ohio. Special attention is given to the patented Buckeye "Mevac" metered vacuum power control system for all operations.

Other details of design and construction are also covered fully, and the adaptability of the machine shown by action pictures of jobs in progress. The Buckeye Clipper is built in three sizes— $\frac{1}{2}$, $\frac{3}{4}$ and $\frac{3}{4}$ -yard capacities, convertible to: shovel, trench hoe, crane, clamshell, dragline and pile

driver. "Mevac" power control is used on all models.

Copies of this bulletin are available upon request to the company.

Trailers, Tractors and Trucks—A pictorial story of heavy hauling is given in a handsome 12-page folder recently issued by The Euclid Road Machinery Co., Cleveland, Ohio. Interesting hauling records and lists of Euclid's owned by contractors in various parts of the country are given, with other pertinent information. The folder, entitled "Cross Country Winners," is available on request.

Adams Pictorial News—This is an attractive, photogravure-style publication, showing Adams equipment at work on many and various jobs. Brief descriptions cite pertinent facts. There are comments from users, and in some instances production data are given. The paper is obtainable from J. D. Adams Co., Indianapolis, Ind.

Subdrainage With Toncan Products—The foregoing is the title of a 32-page booklet recently issued by Toncan Culvert Manufacturers' Association, Republic Bldg., Cleveland, Ohio. It is an excellent general presentation of problems and their solution; is profusely illustrated with photographs, cross sections, plans and diagrams; and contains tables of weights, quantities and other data to facilitate calculations. Subject matter covers drainage of road beds, structures and land areas.

Aeroil "Heat-Master" Catalog—Just off the press in Catalog No. 182 of the Aeroil Burner Co., West New York, N. J., featuring the new "Heat-Master" kettle for heating and melting tar or asphalt. The kettle comes in a variety of models adapted to all classes of service. The catalog gives specifications and illustrated descriptions of each model, together with miscellaneous useful information.

Corten High-Strength, Corrosion-Resisting Steel—An elaborate 64-page catalog of United States Steel Corp., Pittsburgh, Pa., describes and illustrates many uses of this important product, manufactured by five subsidiaries in various parts of the country. Physical properties, forms available—rolled sections, plates, sheets, and other data are given. A bibliography is included.

Dodge Truck Offers Free Guide For Truck Drivers—A truck driver's guide which helps him to keep operating costs down and to drive with maximum safety, is offered without charge by Dodge Truck Division of Chrysler Corporation, Detroit, Michigan, according to T. W. Moss, Director of Truck Sales.

Written in simple yet forceful language, the guide covers a variety of key subjects, care and treatment of the truck engine; how to make tires last longer; importance of proper treatment of clutch, brakes and transmission; safety and courtesy on the highway and numerous other topics important to truck driving.

The booklets were prepared originally for distribution at Dodge's current "Wheels of Progress" exhibitions, however, great demand for this "Guide for Truck Drivers" has forced Dodge Truck to make a second printing.

Tools and Equipment for Earth Moving in Highway Construction—This is the title of a paper by Frank A. Nikirk, of Caterpillar Tractor Co., Peoria, Illinois, presented at the Twelfth National Asphalt Conference in March of this year. Demand for this paper has been such that Caterpillar has had it printed, and will distribute copies free on request, so long as the supply lasts. Mr. Nikirk develops his subject historically, and gives performance rates for various types of equipment. The study is in no way limited to Caterpillar products.

Koehring Mud-Jack Method—If you are interested in mud-jacking, you find a valuable collection of photographic illustrations and diagrams, with accompanying text and specifications in this newly issued bulletin of Koehring Co., Milwaukee, Wis. Details of the machine and the work done with it are both covered. Line drawings suggest proper procedure for the drilling of holes in concrete slab.

Littleford Maintenance Equipment—An attractive new folder by Littleford Brothers, 457 East Pearl St., Cincinnati, Ohio, pictures and briefly describes the following items of their manufacture:

Pressure distributors, tar and asphalt kettles, utility spray tanks, traffic line markers, tool boxes, emulsion sprayers, wheeled rollers, salamanders, joint fillers, mortar boxes, resurfacers, concrete heaters, weed burners, street flusher, road broom, oil burners, paving tools, pouring pots, powder magazines, surface heaters, tool heaters, lead furnaces, supply tanks.

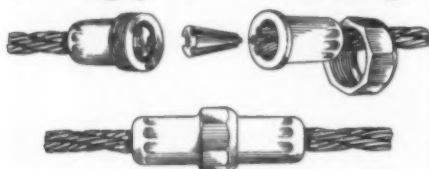
The Facts You Want About Secondary Crushing—Here is something new—not just another catalog—but a valuable discussion of rock crushing.

It discusses the different types of crushers—the purpose of secondary crushers—the advantages of the roll crusher—and the comparison between the gear drive and the chain drive roll crushers.

It tells how to select the size of roll crusher—and how to pick the best type of shells for each job.

It includes full details about every size of Pioneer Roll Crusher and gives capacities—stage of reduction—power requirements—speed of operation—and the percentage of each size of stone in the product.

Guard Cable Splice of Approved Design



This Wedge Type Union Cable Splice for standard 3-strand, 7-wire $\frac{3}{4}$ " guard cable is the simplest, most easily installed and most economical cable splice we know about that will meet specifications requiring safety factor over cable of 25,000 lbs. rating.

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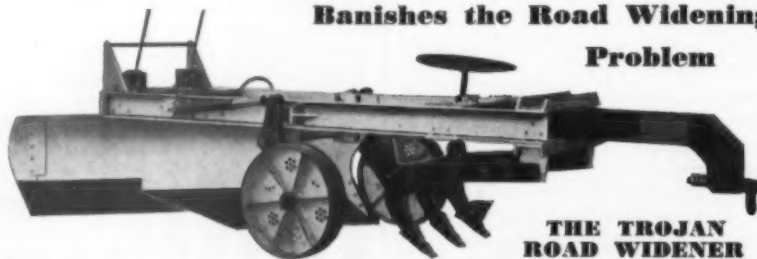
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